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No. [redacted]

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[redacted] INDUSTRIES CORPORATION ET AL.,
Petitioners,

v.

JONES & LAUGHLIN STEEL CORPORATION,
Respondent.

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RESPONDENT'S BRIEF IN OPPOSITION TO
PETITION FOR A WRIT OF CERTIORARI

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IN THE

# Supreme Court of the United States

OCTOBER TERM, 1974

No. 74-1555

KAISER INDUSTRIES CORPORATION ET AL.,
Petitioners,

v.

JONES & LAUGHLIN STEEL CORPORATION,
Respondent.

## RESPONDENT'S BRIEF IN OPPOSITION TO PETITION FOR A WRIT OF CERTIORARI

### OPINIONS BELOW; ORDER DENYING CERTIORARI IN THE McLOUTH CASE

1. The Opinions in the instant case (sometimes hereinafter "the *J&L* case") are: *Kaiser v. Jones & Laughlin,* (C.A. 3, 1975), hereinafter "the Third Circuit decision" and *Kaiser v. Jones & Laughlin,* (W.D. Pa., 1974), hereinafter "the Pennsylvania District decision". The Third Circuit decision; App. 1-41*; has not yet been officially reported. A motion seeking amplification of certain wording therein; Resp. App. 1a; was filed April 18, 1975, and remains pending and undecided. The Pennsylvania District decision; App. 43-601; is not officially reported.

*References herein to the Appendix to the Petition are designated "App. ....." References to the Appendix to this Brief in Opposition are designated "Resp. App. ....."

2. The Judgment in this, the *J&L* case; App. 42; ordering dismissal of the Complaint on the ground of collateral estoppel, is based upon a final adverse judgment petitioners suffered in litigation in the Sixth Circuit, hereinafter "the *McLouth* case", in 1966. The opinions in that case are *Kaiser Industries Corp. v. McLouth Steel Corp.*, (C.A. 6, 1968) 400 F.2d 36; App. 603-44; hereinafter "the Sixth Circuit decision", and *Henry J. Kaiser Co. v. McLouth Steel Corp.*, (E.D. Mich., 1966) 257 F.Supp. 372; App. 645-804; hereinafter "the Michigan District decision".

3. The Order of this Court denying Kaiser's petition for certiorari in the *McLouth* case; No. 949, October Term, 1968; is reported at 393 U.S. 1119 (1969).

## RESPONDENT'S GROUNDS OF OPPOSITION TO THE PETITION

1. This is an ordinary patent case: It involves no issues, the settlement of which is of public importance. The patent was held invalid in 1966 and expired in 1974. There is no conflict of circuits. The only thing decided below is that the application of *Blonder-Tongue* to the particular state of facts here presented compels a holding of collateral estoppel. In so holding, the Third Circuit applied *Blonder-Tongue* as written, and consonant with the holding of every Court of Appeals which has been called upon to apply it.

2. The petition does not fairly or accurately state the *ratio* of the Third Circuit decision. The Third Circuit did *not* fail or refuse to "follow this Court's decision in *Blonder-Tongue*" (cf. Ptn. p. 15) in any particular; specifically, it did *not* disregard the "justice and equity" admonition of *Blonder-Tongue* (cf. Ptn. p. 2). Stated in simplest terms, the view of the Pennsylvania District court was that "justice and equity" precluded the application of collateral estoppel because, in the opinion of that court, petitioners' patent was a meritorious one and should have been upheld in the *McLouth* proceedings. In so holding, the Pennsylvania District court did *not* conduct a "principled" inquiry into the question whether petitioners had had a full and fair opportunity to litigate their patent in *McLouth* (cf. Ptn. pp. 12, 17, 20, 22) but a misdirected, and legally indefensible one. The philosophy of the Pennsylvania District court is plainly contrary both to the letter and the paramount purpose of *Blonder-Tongue*. The Third Circuit properly observed that the Pennsylvania

District court's view would "perforce eliminate substantially all collateral estoppel under the new *Blonder-Tongue* precept."

3. There were no "fundamental defects" in the *McLouth* proceedings (cf. Ptn. p. 22), and petitioners were fully and fairly heard therein. The complaints petitioners now voice were never voiced to the *McLouth* courts: (i) Petitioners did not assert that the Michigan District court had failed to grasp the technical subject matter (cf. Ptn. pp. 26-27); to the contrary, they asserted in the Sixth Circuit that the trial judge had found the facts correctly and had "merely erred as a matter of law on the construction of the patent"; (ii) petitioners did not complain that the Michigan District court, by basing its holding of file wrapper estoppel on the file wrapper itself,* had deprived them of crucial evidence without fault of their own (cf. Ptn. p. 23); to the contrary, they simply argued to the Sixth Circuit that the holding on file wrapper estoppel was erroneous in law; and (iii) petitioners did not assert, either in the Michigan District court or the Sixth Circuit, or in their petition for certiorari, any irregularity or bias in the *McLouth* proceedings** (cf. Ptn. pp. 17-18, 20-22); to the contrary, petitioners' contention in the Sixth Circuit, in their petition for certiorari, and even in their public pronouncements, was simply that the *McLouth* courts had applied erroneous standards of claim construction

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*The file wrapper was put in evidence by the petitioners.

**Neither did the Government of Austria in its *amicus* brief in support of the petition for certiorari in the *McLouth* case, No. 949, October Term, 1968; 393 U.S. 1119.

to the language of the Suess claims; specifically, that they had adopted too strict a rule of claim construction.

Moreover, petitioners have now shifted position on the issues of "deprived of crucial evidence without fault of their own" and "utter failure to grasp the technical subject matter and issues", thereby tacitly conceding that the Third Circuit ruled correctly on these issues as they were presented to it.

4. Petitioners' troubles are all of their own making; and, if petitioners ever had (or thought they had) any cause for complaint about the *McLouth* proceedings, they knowingly waived and abandoned it. Petitioners had timely opportunity to make their complaints to, and to seek relief from, the *McLouth* courts but elected not to do so; indeed, petitioners admitted this at the argument in the Third Circuit.

5. Neither the courts nor the defendants in this and the thirteen other pending cases should be burdened further with litigation over a patent which petitioners have already litigated to a finish in a forum of their own choosing: The burdens on the litigants and the expenditure of judicial time have already been enormous. The *McLouth* litigation went on for twelve years and took two full years of the trial judge's time. The *J&L* case came on for trial after six years of pretrial proceedings. The trial was held in the period October, 1967-March, 1968, and briefs were filed. The collateral estoppel issue intervened and was tried and argued in September, 1971. There was an argument on the merits in December, 1971. The opinions were handed down in January, 1974, and amended in February, 1974. The *McLouth* holdings are manifestly correct; and undisputed evidence in this

record (largely petitioners' own admissions) which the Third Circuit has not yet had occasion to consider, establishes that the Suess patent was obtained by fraud and is invalid on that and other grounds not established in *McLouth;* and is unenforceable because of petitioners' fraud in the Patent Office and unclean hands in the conduct of the infringement actions; and also that Suess has never been infringed.

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## COUNTERSTATEMENT OF THE CASE

### 1. Status Of The Other Infringement Cases.

All in all, there are thirteen infringement actions which are yet untried (Ptn. p. 5, fn. 4). These cases have all been transferred to the Pennsylvania District court for coordinated or consolidated pretrial proceedings; *In re Suess Patent Infringement Litigation,* (JPML, 1971) 331 F. Supp. 549. That court stayed all discovery immediately after the transfer, and the stay has not yet been lifted.

After respondent took its appeal in this, the *J&L* case, petitioners moved for partial summary judgment in each of the several transferred cases demanding a judgment (i) that they are not collaterally estopped therein by the *McLouth* judgment and (ii) that the Suess patent is valid*, leaving nothing but the question of infringement open for determination. The several defendants, relying on *Blonder-Tongue,* 402 U.S., at 329, protested that they had never had their day in court and that Due Process entitled them to challenge validity on the merits, or on collateral estoppel, or both. Instead of denying the motions out-of-hand, however, the Pennsylvania District court took them under advisement, and there they remain.

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*Petitioners' argument is that the patent has been held valid by the Western District court in the *J&L* case; that in the opinion of petitioners' counsel, everything that can be said about validity has already been considered in the *J&L* case; and that under the doctrine of *stare decisis* judgment of validity should be entered *instanter!*

**2. Petitioners' Commercial Success Is Not Due To Anything Claimed In The Suess Patent.**

(a) Petitioners' claim that the Suess patent revolutionized the art, which underlies the whole petition (Ptn. pp. 3-5, 20-21; App. 152-153), is wholly unjustified. It is true that the *McLouth* courts were persuaded that Suess is the fundamental United States patent in this art, but those courts did not have the benefit of evidence adduced for the first time in the *J&L* case* showing that petitioners themselves attributed the commercial success to the prior art (notably Schwarz, Miles and Durrer, discussed *infra*), nor were they aware that fifteen months prior to taking out the Suess patent, petitioners had procured the virtually identical Cuscoleca patent (discussed *infra*) and had attributed to Cuscoleca everything they now attribute to Suess.

Moreover, what the *McLouth* courts praised is what the Suess patent discloses in its *specification,* and not what it *claims.* This Court observed a century ago** that a patent specification is "necessarily largely occupied with what is not new, in order to an understanding of what is new", and it is now apparent that the Suess

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*The Pennsylvania District court ignored that evidence, and the Third Circuit has not yet had occasion to consider it. It is clear, however, that the Third Circuit did not put its *imprimatur* on the laudatory statements in the *McLouth* opinions; cf. Ptn. p. 14, and Respondent's Motion for Amplification; Resp. App. p. 1a-8a. Petitioners opposed the motion, but only on the ground that nothing in the Third Circuit's practice provides for it; petitioners did not dispute any of the matters set forth in the motion or the supporting memorandum.

**_Merrill v. Yeomans,_ (1876) 94 U.S. 568, 570.

specification is largely occupied with what was not new with Suess but was derived from others.

(b) The prior workers from whom petitioners principally derived the content of the Suess patent specification were *Schwarz,* an engineer employed by the consulting firm of H. A. Brassert & Co. of Berlin-Charlottenburg; *John Miles & Partners,* an English consulting firm; and *Prof. Robert Durrer,* a world renowned Swiss metallurgist and then a Director of the leading steel manufacturer in Switzerland, Von Roll AG, with steelworks at Gerlafingen. The work of all of them is admittedly prior to Suess.*

**Schwarz:** A German patent, No. 735,196, covering Schwarz's work issued on July 3, 1943 (Resp. App. 9a). Schwarz discloses the refining of pig iron into steel by blowing a jet of pure oxygen downwardly onto the center of the surface of the molten bath. He states that the jet "penetrates", i.e., indents the bath but does not state the depth of penetration in inches or centimeters, simply that the reaction "takes place in the center of the steel bath", thereby eliminating "the danger of rapid wear" of the lining of the vessel.

Petitioners' commercial exploitation of Basic Oxygen Steelmaking was in November, 1952, under the name "LD-Process". One of petitioners' first acts in the worldwide exploitation of the process (cf. Ptn. pp. 4-5) was to acquire the Schwarz patent, pursuant to a policy of acquiring *all* "knowledges, experiences and patents on oxy-

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*The earliest invention date asserted for Suess is June 25, 1949. Claims calling for the avoidance of material agitation were first presented to the Patent Office on June 11, 1957.

gen refining, so that it can be avoided, that one single patent holder is played off against the other" (Resp. App. 10a).

Shortly after the acquisition, BOT acknowledged the viability and commercial importance of the Schwarz patent in a confidential memorandum to Kaiser and said that BOT had acquired Schwarz because it was basic to petitioners' "LD" process (Resp. App. 11a).

In September, 1953, Kaiser published "Oxygen Steelmaking In The United States" in which it attributed petitioners' commercial success entirely to the Schwarz* patent (Resp. App. 12a-13a).

**Miles** (Resp. App. 14a): There are Miles patents in several countries. Petitioners acquired them pursuant to the policy above described (Resp. App. 10a). Miles is like Schwarz in that it discloses blowing oxygen downwardly onto the molten bath. Miles is more detailed than Schwarz, however, notably in that Miles gives a specific example stating oxygen flow rate, nozzle size, etc., from which the depth of penetration can be calculated by those skilled in the art.

The undisputed evidence in this record (not present in the *McLouth* record) is that, measured by the formula vouched for by petitioners' experts, the jet penetrates *less* deeply in Miles than in Suess (Resp. App. 39a).

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*The Kaiser publication also calls the Schwarz process the "Brassert" process, this because the Schwarz patent issued to H. A. Brassert & Co. and was acquired by petitioners from Brassert.

**Durrer:*** Prof. Durrer is a distinguished Swiss metallurgist who, with his associate, Dr. Hellbrugge, successfully demonstrated the oxygen refining process in a 2-ton converter at the Von Roll steelworks in Gerlafingen, Switzerland, following work on a laboratory scale at the Technische Hochschule in Charlottenburg, while Durrer was Professor of Metallurgy there. The Gerlafingen tests commenced in March, 1948, and continued into April, 1949, when the output of the 2-ton converter was directed to the commercial production of steel.

Petitioners' work at Linz, upon which the Suess patent is allegedly based, commenced in June, 1949 (the asserted invention date is June 25, 1949) and was carried out in a 2-ton converter. Durrer's work at Gerlafingen was known to petitioners before any work was done at Linz; specifically, Suess and co-patentee Trenkler visited Gerlafingen during the test period, as did Dr. H. Richter-Brohm, then the General Manager of VOEST. The inquiries by Suess and Trenkler into Durrer's work were mandated by Richter-Brohm, who was seeking an alternative to the open-hearth process for steelmaking at VOEST's steelworks in Linz, then in process of reconstruction after its destruction during wartime. Hellbrugge wrote Trenkler on April 3, 1949, informing him that the test work had been successfully completed and "We are now working for production . . ." Trenkler visited Gerlafingen on May 12 and conferred with Durrer. He reported the success of the Gerlafingen work to his superiors and recommended that similar

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*The facts here related are largely admitted or undisputed. They appear in the printed record on appeal, now lodged with the Third Circuit. See also Resp. App. 16a-19a.

tests be run at Linz under the *aegis* of Durrer to establish the viability of the process for refining the unique pig-iron—"Linz stahleisen"—available at Linz. The first series of tests at Linz—admittedly made according to Durrer's teachings—were entirely successful and were so reported to Richter-Brohm and Suess. The converter vessel was then scaled-up successively to 5-tons, 15-tons and 30-tons capacity. The decision to install the Durrer process at Linz (rather than open-hearths) was made December 9, 1949. On that day, Suess (with co-patentee Trenkler's and Hauttmann's acquiescence) told Richter-Brohm that nothing inventive had been done at Linz. Thereupon, at the suggestion of Hauttmann, the process was christened "LD-process", meaning "Linz-Durrer process".

**Cuscoleca:** The Cuscoleca patent (Resp. App. 21a-30a), issued April 10, 1956, No. 2,741,555. Suess issued July 24, 1957. It is facially apparent that the two are virtually identical; cf. App. 805-34 and Resp. App. 31-36a. The drawings are precisely the same and the thrust of the specifications, including the assertion of novelty, is the same; even the wording is identical in large part.

### 3. Proceedings In The Patent Office.

Petitioners' contention throughout the proceedings in the Patent Office was that in Schwarz and Miles the penetration was deep and in Suess it was "practically negligible" (App. 628-29). In June, 1957, petitioners represented, with supporting affidavits of co-patentees Rinesch and Hauttmann, that they had attempted to practice the teachings of Schwarz and Miles but had suffered complete failure; and that they had turned failure

into success by the discovery that deep penetration must be avoided.

Petitioners did not disclose to the Patent Office what they had elsewhere acknowledged—that Schwarz had been entirely successful and that petitioners' commercial success had been built upon it and not upon Suess (*supra,* p. 10). Neither did petitioners disclose to the Patent Office that instead of the Suess penetration being "practically negligible" in comparison with Miles, it is actually deeper (Resp. App. 39a).

Petitioners also concealed their publication "Oxygen Steel" (Resp. App. 37a) from the Patent Office. That publication describes the workings of the oxygen steelmaking process in full detail and acknowledges that the "characterizing restricted reaction zone" (cf. Ptn. p. 7) "holds good even on deep penetration".

Petitioners also withheld from the Patent Office all knowledge of their derivation of the process from Durrer; *supra,* p. 11.

**4. Proceedings In The McLouth Litigation.**

Petitioners' account of the *McLouth* proceedings (Ptn. pp. 2-10) requires enlargement and correction in important respects:

(a) Petitioners first sued *McLouth* on the Cuscoleca patent (*supra,* p. 12) but withdrew that charge and sued on the Suess patent as soon as it issued. Petitioner's reason for this was stated by Kaiser in a letter dated January 20, 1960, as follows: "The Cuscoleca patent expires before the Suess patent, and * * * it was decided as a matter of litigation and trial strategy, not to pursue the Cuscoleca patent against McLouth" (Resp.

App. 38a). McLouth, unaware of this, did not defend on the ground of double patenting, as *J&L* has done here.

(b) Petitioners did not reveal to the *McLouth* courts what they had published in "Oxygen Steel" and "Oxygen Steelmaking In The United States" (*supra,* p. 13, p. 10) or that the penetration in Suess is deeper than in Miles (*supra,* p. 10).

(c) Durrer and Hellbrugge both testified at the *McLouth* trial but neither McLouth's trial counsel nor the *McLouth* courts had the benefit of crucial evidence outlined *supra,* pp. 9-12.

Even on the limited record before it, the Michigan District court paid high tribute to Durrer (App. 745): "Indeed, in any objective sense, it would have to be said that Dr. Durrer and Dr. Hellbrugge contributed as much, if not more, to the discovery of the successful oxygen steelmaking process than the patentees". The Michigan District court ruled, however, that the "last step"—the discovery that deep penetration must be avoided in a successful steelmaking operation—had been taken by Suess and that it was unobvious (App. 746).* Plainly, this conclusion would not have been reached if petitioners had revealed that their commercial success was based upon Schwarz (*supra,* p. 10) and that everything they had attributed to the avoidance of deep penetration "holds good even on deep penetration" (*supra,* p. 13).

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*The Sixth Circuit disagreed with the conclusion that avoidance of deep penetration was unobvious but did not remand the case for further testimony because it could affirm on the ground of invalidity under Section 112 (App. 626-27).

(d) It is apparent from the *McLouth* Opinions themselves (App. 603-44, 645-804) that the *McLouth* courts had a clear grasp of the technical subject matter and issues (cf. Ptn. pp. 12, 13, 21, 22, 26, 27). The pertinent portion of the Third Circuit Opinion appears at App. 34-36.

Petitioners never made any such contention in the Michigan District court.

During the pendency of the appeal, petitioners published and widely distributed in the trade an "L-D Process Newsletter" announcing that an appeal had been taken. Petitioners did not there assert any failure of the Michigan District court to grasp the technical subject matter; to the contrary, they lauded its grasp, said simply that the patent had been held invalid "for failure to comply with certain technical requirements of the patent laws as to definiteness of the claims" and stated that their appeal was "based on the strict interpretation of these requirements taken by the district court".

Petitioners' brief on appeal to the Sixth Circuit contained no assertion that the Michigan District court had failed to grasp the technical subject matter and issues; the sole contention was that the Michigan District court's "holding of invalidity stems from errors of law, namely, failing to construe a limitation in the claims in accordance with the meaning attributed to it" by the patentees, etc.

In petitioners' oral argument in the Sixth Circuit, petitioners' counsel said:

> "The Court below did a magnificent job in analyzing most of the factual evidence before it; but it erred as a matter of law in regard to the con-

> struction of the document before it, and I say that if the claims are properly construed to embrace this novel concept of the patentees, which they obviously were intended to cover, all the difficulties encountered by the Court below in the last portion of its opinion are set straight."

Similarly, in their petition for certiorari, petitioners asserted only that the Sixth Circuit had made errors of law.

(e) Petitioners never complained to the *McLouth* courts that they had been deprived of crucial evidence without fault of their own (cf. Ptn. pp. 13-14, 23-26). The pertinent portion of the Third Circuit Opinion appears at App. 30-33.

Petitioners themselves put the file wrapper in evidence. During the course of final argument in the Michigan District court, Judge Freeman asked counsel why the words "avoid deep penetration" did not appear in the final claims.* Counsel responded that he would "have to look at the file history" in order to answer and that he would reply immediately after the recess. After counsel gave his answer, the Court inquired "If the claims are cancelled, the new claims cannot be construed to cover the cancelled claims, can they", to which plaintiffs' counsel answered that they could be so construed. The Michigan District court, citing numerous decisions

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*The Pennsylvania District court later suggested (App. 108) that petitioners' counsel was putting on a "selling campaign" for the proposition that avoidance of deep penetration was the gist of the Suess invention and "in very great likelihood oversold the feature" to the Michigan District court. Petitioners have expressed no disagreement with that comment.

of this Court, held that the doctrine of file wrapper estoppel applies (App. 764-67).

Petitioners did not petition the Michigan District court for reconsideration or rehearing, or otherwise complain because the court had based its ruling on the file wrapper itself.

On appeal, petitioners made no complaint that they had been deprived of evidence, "crucial" or other. They simply argued that, as a matter of law, there was no file wrapper estoppel. The Court of Appeals gave the question detailed consideration and held (Judge Edwards dissenting) that petitioners were estopped by the file wrapper (App. 635-644).

Petitioners did *not* request a rehearing and remand on this point (cf. Ptn. p. 10). They petitioned simply for a "rehearing on this appeal" to be heard before the court *en banc*. The only thing they said about the state of the record on the petition was this: Petitioners asserted that the Sixth Circuit had based its holding on an "inference" of abandonment, that abandonment is "not to be presumed, but must be clearly proven" and "if the court is in doubt, it should remand the case for findings on the factual question of abandonment". Evidently the court was *not* in doubt because the petition was denied.

In its petition for certiorari which followed, petitioners made no complaint that they had been deprived of crucial evidence; merely that the Sixth Circuit had fallen into errors of law in holding file wrapper estoppel.

**5. Proceedings In The Pennsylvania District Court.**

Petitioners' assertion that the Pennsylvania District court conducted a "principled" inquiry into the collateral estoppel issue (Ptn. pp. 12-14, 20-22) requires enlargement and correction in important particulars:

**(a) The rationale of the inquiry:** Commencing with the fact that the *McLouth* courts [on the limited evidence before them; *supra* p. 14] had declared that Suess made a revolutionary invention (App. 139), and being persuaded that it would be unjust to apply the doctrine of collateral estoppel because the purpose of the patent laws is to encourage and protect inventiveness (App. 152-53), the Pennsylvania District court rationalized as follows:

> (i) The *McLouth* judges were not skilled in the art and therefore were "compelled" to make their determinations "on the basis of credibility of witnesses" and to rely upon the testimony of experts (App. 167).
>
> (ii) The Pennsylvania District court, aware of its own inadequacies in the art, acquired from outside sources "considerable technological education and insight into the scientific features involved" and "attempted to extract scientific facts from the published authorities" (App. 96, 167).
>
> (iii) Thus armed, the court "re-examined" the *McLouth* evidence wherever "the experts' conclusions clashed with what my research revealed to be scientific principles". In brief, its outlook was that the Michigan District court "found as best it could from the mass of evidence and exhibits, most of which could not be detailedly and fully examined, no

special significance to the technology involved in the subject matter, while I on the other hand was not so hampered" (App. 39, 96).

(iv) Guided by "hindsight" (App. 169) and unhampered by the evidence upon which *McLouth* courts necessarily based their decisions (App. 39), and with numerous excursions outside the record (App. 82, 90-1, 92-3, 93-4, 96, 96-7, 167, 203-04, 238, 259, 335, 338), the Pennsylvania District court reviewed the *McLouth* proceedings in minute detail both at the trial level and the appellate level, and concluded that those courts should not have decided as they did.

**(b) Inquiry into the mental processes of the Michigan District court:** The Pennsylvania District court perforce conceded that there is ample evidence in the *McLouth* record to support the conclusions reached therein. Nevertheless, it inquired minutely into the mental processes of the Michigan District court and [with the benefit of hindsight and unhampered by the evidence] concluded that the Michigan District court had reasoned erroneously (App. 96).

**(c) Inquiry into the relative credibility of witnesses:** In making certain of its fact findings, the Michigan District court weighed the relative credibility of the witnesses, notably McLouth's expert, Dr. Flinn, and petitioners' expert, Dr. Elliott. The Pennsylvania District court reviewed these findngs and concluded therefrom that the Michigan District court should not have resolved the conflict in the way it did, and further that the rejection of Dr. Elliott's testimony shows that the

Michigan District court was lacking in technical understanding:

(i) In one situation, the Michigan District court rejected Dr. Elliott's testimony, partly because Elliott's testimony was predicated on the proposition that circulation at the center of the bath can be up and down at the same time—an obvious physical impossibility. The Pennsylvania District court, however, said, that "my study" based more on "common knowledge than on any knowledge of physics" shows paradoxically that the circulation can be up and down in the center at the same time (App. 92-93);

(ii) In another situation, the Michigan District court found with Dr. Flinn regarding the conclusions to be drawn from an open test conducted by Dr. Flinn and which the Michigan District court itself had witnessed. The Pennsylvania District court bitterly criticized Dr. Flinn, made computations of its own and concluded that the tests were disqualified as "competent evidence in the case of the technicality involved" (App. 83-96). The computations made by the Pennsylvania District court are egregiously in error. This was demonstrated in a computation which respondent laid before the Third Circuit when this case was argued there (Resp. App. 41a). Petitioners have never questioned that it proves that Dr. Flinn was right and the Pennsylvania District court was wrong.

**(d) "Without fault of their own":** The Pennsylvania District court repeatedly reconstrued positions taken by petitioners' counsel in the *McLouth* case and

gave reasons, never urged by petitioners themselves, to excuse binding petitioners to the manner in which they conducted the *McLouth* trial (App. 39). More particularly:

(i) "I, by hindsight, now realize that counsel for the plaintiffs might have pointed to much in the specifications for answers to the district court's questioning * * *" (App. 105).

(ii) "* * * plaintiffs' counsel * * * put on a 'selling campaign' to the district court of 'reduced impact pressure of the jet on the bath so as to avoid deep penetration' and * * * he in very great likelihood oversold the feature at the trial" (App. 108).

(iii) Petitioners' counsel were derelict in failing to point out to the *McLouth* courts that Suess was the first to create a localized reaction zone (App. 106).

(iv) Petitioners' counsel were "respectfully submissive" and "overly agreeable" in their presentation of the case and did not answer questions put to them by the Michigan District court as the Pennsylvania District court believes they should have been answered (App. 149-150, 394).

(v) Petitioners' arguments in these and other regards did not "misguide" the Michigan District court, however, because "it was the master of its own thinking" (App. 150).

**(e) The holding in McLouth that "avoidance of deep penetration" is the gist of the Suess invention:** The holdings of the *McLouth* courts are all predicated on the proposition that the avoidance of deep penetration is the gist of the Suess invention. In a wide-ranging critique of the

*McLouth* decisions, the Pennsylvania District court held that the avoidance of deep penetration is not the gist of the invention (App. 67-69, 118, 366-68); that the holding of the *McLouth* courts that "avoid material agitation" is not the equivalent of "avoid deep penetration" stems from their failure to realize that Suess was the first to create a localized reaction zone (App. 101-03, 149-50, 382-412); that the Suess invention was not made on June 25, 1949, as was asserted to the Patent Office, but was actually made late in 1950 (App. 97-101, 366-71); and consists of the wealth of detailed operating instructions contained in the Suess specification (App. 99-100). The route by which the Pennsylvania District court arrived at these conclusions was briefly as follows:

**Avoidance of deep penetration:** On this score, the Pennsylvania District court held: (i) The patentees were wrong in testifying that the *only* difference between Suess and the prior art is that Suess avoids deep penetration (App. 99-100, 118, 371-72, 375). (ii) Petitioners' counsel did not understand the Suess process (although they had been steeped in the litigation for more than eight years) and were wrong in representing to the Michigan District court that avoidance of deep penetration is the gist of the invention (App. 101-02, 382-412, 538-39).* (iii) The Michigan District court was wrong in accepting the testimony of the patentees and the contention of petitioners' counsel and holding, consonant therewith, that avoidance of deep penetration is the gist of the invention. Its failure to do so demon-

*The same counsel asserted, both in the Sixth Circuit and in their petition for certiorari in *McLouth*, that avoidance of deep penetration *is* the gist of the invention. The Pennsylvania District court makes no mention of this.

strates that the Michigan District court did not know what the Suess invention is (App. 67, 118-19, 366-67, 375-76, 410-12).

**Localized reaction zone:** On this score, the Pennsylvania District court held: (i) If the patentees, petitioners' counsel and the *McLouth* courts had correctly understood the invention, they would have realized that the presence of a localized reaction zone is what really differentiates Suess from the prior art (App. 71-72, 134-35, 268-69, 273-74, 281, 478-79). (ii) The Michigan District court, basing its finding upon the language of the Schwarz and Miles patents and the expert testimony before it, held that there is a localized reaction zone both in Schwarz and Miles* (App. 712) but the Pennsylvania District court said that "the technical difference" between Suess and the prior art "may not have been properly clarified in the prior Courts, because the term 'hot spot' " was indiscriminately used (App. 269) and that it was "unfortunate" that petitioners' principal expert, Dr. Chipman, used the word "spot" and "not 'region' or 'area' to differentiate the Miles-Schwarz 'area' from the 'zone' in Suess" (App. 274).

**The "actual" Suess invention:** The file wrapper shows that petitioners asserted an invention date of June 25, 1949, and they have adhered to this assertion throughout the litigation. Consonant with its rejection of "avoid deep penetration" as the gist of the invention, the Pennsylvania District court held: (i) The invention was not made on June 25 but at a much later time—late

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*It is now known that petitioners unqualifiedly admitted in "Oxygen Steel" that the localized reaction zone "holds good even on deep penetration" (Resp. App. 37a).

1950 (App. 366-71); and (ii) The Suess invention actually consists of the wealth of detailed operating instructions contained in the Suess specification, such as "character of vessel, size of nozzle, pressure and height of nozzle, vertical and central placement of nozzle, and ratio of bath depth to surface area and the reasons therefor, * * *" (App. 218).

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## ARGUMENT

### I. Petitioners Knowingly Waived And Abandoned The Complaints They Now Voice.

We submit *in limine* that petitioners are barred by waiver and abandonment. They acknowledged in the Sixth Circuit that the Michigan District court had found the facts correctly and bottomed their appeal solely on questions of law; *supra,* p. 4, pp. 15-17. If they thought they had just ground for complaint about the conduct of the *McLouth* case, particularly as regards deprival of evidence, or failure of the trial judge to understand the subject matter, or his resolution of conflicting evidence, they had ample opportunity to seek relief in the *McLouth* courts. But they decided not to do so; *supra,* p. 5.

By proceeding thus, petitioners waived all of the complaints upon which the petition is predicated; *Hubbell v. United States,* (1898) 171 U.S. 203, 208; *Law v. United States,* (1925) 266 U.S. 494, 496; *Woolworth Co. v. Contemporary Arts,* (1952) 344 U.S. 228, 231.

### II. The Pennsylvania District Court's Inquiry Was Not "Principled".

1. The inquiry was *misdirected:* The only proper purpose of such an inquiry is to ascertain whether the patentee had a fair opportunity "to pursue his claim the first time"; *Blonder-Tongue,* 402 U.S., at 333. Whether the *McLouth* case was correctly decided is not the issue here; *Blonder-Tongue,* at 331-32; *Blumcraft of Pittsburgh v. Kawneer Company, Inc.,* (C.A. 5, 1973) 482 F.2d 542, 546-7; *decision below,* App. 23-24. The inquiry of the district court in this case was contrary to the *Blonder-Tongue* doctrine, the twisted chain of argument being (i) *McLouth* was wrongly decided, (ii) the errors

of the *McLouth* courts were due in part to erroneous conclusions they drew from the evidence and in part from errors of law; (iii) these errors demonstrate that the *McLouth* courts did not understand the subject matter; hence (iv) petitioners did not have a full and fair opportunity to present their case.

2. The inquiry was *legally indefensible,* not only because of its excursions outside the record but also because of its fault-finding with the Michigan District court on the resolution of conflicting testimony, and its conclusion, based on hindsight, that the *McLouth* courts had "misread" and "misinterpreted" the Suess patent, etc. (App. 39-40).

3. Even as respects the substantive issues in *McLouth,* the district court's inquiry was wide of the mark: The primary holding of the *McLouth* courts was that the Suess claims did not define the supposed invention as required by 35 U.S.C. 112 but were unduly broad and encompassed prior art (App. 635, 799-801). The Pennsylvania District court did not come to grips with this holding but held, instead, that the Suess invention actually consists of a wealth of details contained in the Suess specification but not in its claims; *supra,* pp. 23-24. This merely emphasizes the invalidity of the Suess *claims* under Section 112; *Altoona Theatres v. Tri-Ergon Corp.,* (1935) 294 U.S. 477, 487; *Gen. Electric Co. v. Wabash Co.,* (1938) 304 U.S. 364, 369-70; *United Carbon Co. v. Binney Co.,* (1942) 317 U.S. 228, 236.

### III. The Third Circuit's Application Of Blonder-Tongue Was Correct In All Respects.

1. The Third Circuit did *not* fail or refuse to follow this Court's decision in *Blonder-Tongue* (cf. Ptn. p. 15,

17-29). To the contrary, the opinion shows on its face that the Third Circuit, with the paramount purpose of *Blonder-Tongue* in mind, followed it to the letter (App. 21-36).

The Third Circuit did not set up a bar to relitigation of patent validity issues any more stringent than *Blonder-Tongue* itself prescribes. There is no conflict of circuits. To the contrary, the Third Circuit decision is consonant with every decision of the Federal Courts on the subject, save for the district court decision herein which the Third Circuit found it necessary to reverse.

2. There were no "fundamental defects" (cf. Ptn. p. 22) in the *McLouth* proceedings (*supra,* pp. 4, 13-17). Petitioners' contentions here are plainly afterthoughts of the sort condemned in *United States v. Adams,* (1966) 383 U.S. 39, 49. Petitioners tendered straightforward issues of law on their appeal to the Sixth Circuit and lost. It was only after the denial of certiorari that they suggested deprival of evidence or other irregularities in the proceedings.

3. Petitioners have shifted ground on both of their major contentions: (i) On the question of file wrapper estoppel, petitioners' contention below was that they had been deprived of crucial evidence without fault of their own. Having lost on that issue (App. 29-33), they now contend that file wrapper estoppel was improperly invoked in *McLouth* because the *McLouth* courts refused to consider the affidavits contained in the file wrapper (Ptn. pp. 24-26). Petitioners' present complaint thus reduces itself to the proposition that the *McLouth* courts should have decided differently on the evidence before

them. (ii) Petitioners' originally contended below that the *McLouth* courts had "wholly failed to grasp the technical subject matter and issues". Having lost on that issue (App. 34-36), petitioners now disavow the earlier contention and complain, instead, that the *McLouth* courts failed to grasp certain "significant technical matters bearing upon the proper construction of the Suess patent claims, and that the construction of the claims has become the key issue in this litigation" (Ptn. pp. 26-27). This is simply another way of saying that petitioners want to be heard again on a matter which they tendered to the Sixth Circuit as an issue of law—and lost on it.

4. There is no real comfort for petitioners in *Halpern v. Schwartz,* (C.A. 2, 1970) 426 F.2d 102, 105 (Ptn. p. 24). The Third Circuit ruled against petitioners on this issue (App. 28, fn. 74). Its decision is in full accord with *Restatement (Second) Judgments* § 68; see Comment *"o. Effect of an appeal",* p. 161.

## IV. Relieving Petitioners Of Collateral Estoppel Would Place An Intolerable Burden On The Federal Courts.

The facts recied *supra,* pp. 5-6, 7, show the magnitude of the Suess patent litigation to date and what is to be expected in the future if petitioners have their way. Petitioners' contention that the reviewing court should not confine its review to the question of "full and fair opportunity" but must also redetermine the outcome of the first case would do more than merely reinstate *Triplett v. Lowell,* (1936) 297 U.S. 638—would impose upon the Federal courts a burden staggeringly greater than they had to carry under Triplett.

*Argument.*

The Third Circuit properly observed (App. 26) that acceptance of petitioners' contentions "would perforce eliminate substantially all collateral estoppel under the new *Blonder-Tongue* precept."

## V. There Is Nothing About This Case Which Calls For Review By This Court.

It is clear from the foregoing (i) that petitioners irrevocably waived and abandoned all their contentions by their conduct of the *McLouth* case, and (ii) that this case does not come within the purview of Rule 19 (b):

No principle, the settlement of which is of importance to the public, is involved; *Forsyth v. Hammond,* (1897) 166 U.S. 506, 513-4; *United States v. Rimer,* (1911) 220 U.S. 547, 548; *Layne & Co. v. Western Well Works,* (1923) 261 U.S. 387, 393; *Magnum Co. v. Coty,* (1923) 262 U.S. 159, 163.

There is no conflict of circuits, either as regards the invalidity of the Suess patent or the interpretation of *Blonder-Tongue; Layne & Co. v. Western Well Works, supra; Keller v. Adams-Campbell,* (1924) 264 U.S. 314, 319-20.

The Third Circuit correctly applied the *Blonder-Tongue* criteria. What plaintiffs are really seeking is another review of the evidence and the inferences drawn from it; *Tyrrell v. District of Columbia,* (1917) 243 U.S. 1, 6; *Magnum Co. v. Coty, supra; United States v. Johnston,* (1925) 268 U.S. 220, 227; *General Pictures Co. v. Western Electric Co.,* (1938) 304 U.S. 175, 179.

The patent in suit has expired and the outcome of the litigation is of no importance to the general public; *Forsyth v. Hammond, supra; Layne & Co. v. Western Well Works, supra.*

## CONCLUSION

The petition should be denied.

Respectfully submitted,

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July 10, 1975.

# APPENDIX TO
# RESPONDENT'S BRIEF IN OPPOSITION TO
# PETITION FOR A WRIT OF CERTIORARI

*Appendix.*

**Motion Of Defendant-Appellant Under Rule 27 F.R. App. Proc. Seeking Amplification Of Certain Wording In This Court's Opinion Filed April 4, 1975**

(1) Defendant calls attention to statements in Part A and Part B of the Opinion of this Court filed April 4, 1975 (hereinafter "the Opinion") laudatory of the Suess patent and implying that the basic oxygen steelmaking process as commercially practiced is based upon matters original with Suess et al., notably:

(i) That Suess is the "fundamental" United States patent on the basic oxygen steelmaking process" (Op. p. 4;* see, also, p. 6).

(ii) That the specific techniques taught by Schwarz and Miles "were never exploited commercially" (Op. p. 6).

(iii) That in contrast to the earlier schemes, the Austrians employed an oxygen jet of more moderate force so that the oxygen jet did not penetrate so deeply into the bath (Op. pp. 6-7).

(iv) That the Suess process differs from the prior art in that it is a "multi-faceted physical-chemical" one (Op. p. 7).

(2) The Opinion states (p. 5) that:

"In light of our disposition of the over-arching issue of collateral estoppel, we need not address the other contentions presented, such as the patent's validity and the alleged infringement."

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*Page references herein are to the folio pages of the printed copy distributed by the Clerk.

*Appendix.*

The exposition of technical facts in Part A and Part B is markedly different from the exposition in the remainder of the Opinion, in that no record basis is stated in Part A and Part B but all facts stated after Part B are documented to the *McLouth* proceedings, notably the Opinion of Judge Freeman. Our concern is that, absent an explanatory statement in the Opinion, its readers will likely assume that the Court has addressed the contentions as to validity, at least to the extent of putting its imprimatur on the laudatory statements above noted.

(3) In the accompanying Memorandum, we show that challenged statements (i), (ii) and (iii) stem directly from Judge Freeman's Opinion and are contrary to undisputed evidence in this case which was not before Judge Freeman. And as regards statement (iv), we show by reference to plaintiffs' own published admissions that the "multi-faceted physical-chemical" phenomena of basic oxygen steelmaking do not result from avoiding deep penetration but are present "even on deep penetration".

(4) Since the *ratio* of the Opinion is that the lower court did not confine its inquiries to proper bounds and delved impermissibly into the merits of the *McLouth* case; that the plaintiffs did have a full and fair opportunity to litigate in a court of their own choosing; and that the judgment herein must be reversed and the complaint dismissed on collateral estoppel alone, consistency alone would seem to argue that the Court disclaim any intention to pass upon the merits of the Suess patent. Moreover, for reasons stated in the accompanying Memorandum, we apprehend that the rights of this defendant and also of defendants in the other pending

cases may be prejudiced if Parts A and B of the Opinion are not clarified.

WHEREFORE, defendant prays that this Court amplify its Opinion by inserting therein (either in the text or in a footnote) a statement to the effect that:

> The statements in Part A and Part B of this Opinion regarding the basic oxygen process and the contribution of the patentees to the art are based upon Judge Freeman's Opinion in the *McLouth* case and not upon the Record in this case; and the Court neither approves nor disapproves them.

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*Appendix.*

**Memorandum In Support Of The Motion.**

— I —

This is *not* a petition for rehearing under Rule 40 but a Motion under Rule 27 which plaintiffs-appellees have the right to oppose if they deem that there are good grounds therefor.

— II —

Passages (i), (ii) and (iii) in the Opinion to which we have called attention have a clear antecedent in the *McLouth* Opinions; all of them, however, are *contrary* to undisputed evidence in *this* Record, none of which was before the *McLouth* Courts and most of which consists of admissions contained in documents published by the plaintiffs themselves.

(i) *" * * * Suess * * * is the fundamental United States patent" on the basic oxygen process (Op. p. 4, p. 6). This stems from 257 F.Supp. at 386, fn. 21.*

On this Record, the Suess patent most assuredly is not fundamental. It is literally a Chinese copy of Cuscoleca Patent 2,741,555 (DX-22; App. A:377a) which the plaintiffs took out more than a year before they got the Suess patent (Dft. Br. 32-33). Everything the Opinion points to as characterizing the basic oxygen process (Op. p. 6) had been described years earlier in Chiswik 2,515,631 (DX-207; App. A:371a). In "Oxygen Steelmaking In The United States" (DX-177A; App. A:313a, 316a), the plaintiffs themselves attributed the basic oxygen process to *Schwarz.**

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*It is true that the Schwarz patent issued only in Germany but it is also true that Schwarz's United States application (DX-6) was *rejected and abandoned* (IX: 6102-3).

Plaintiffs repeatedly asserted in their Confidential Memorandum (DX-7) that the basic invention was made by Schwarz (Dft. Br. 6-7); and in the same Memorandum, they characterized the then-pending Suess application as a mere "extension and supplementation" of the original Schwarz patent. Moreover, it will be recalled that at the argument counsel conceded, in answer to a question by Judge Adams, that the difference between Suess and the prior art is only a difference of degree.

(ii) " * * * *the specific techniques taught by Schwarz and Miles were never exploited commercially" (Op. p. 6). This stems from 257 F.Supp. at 379, 402-03.*

Neither "Oxygen Steel" (DX-1; App. A:304a) nor "Oxygen Steelmaking In The United States" (DX-177A; App. A:313a) was before the *McLouth* Courts. Both were published by the plaintiffs and constitute *admissions* that the plaintiffs commercially exploited Schwarz/Miles and not Suess (see Reply Br. pp. 7-8). Moreover, the patent attorney who prosecuted the Suess application *admitted* (II:927-32) that in his dealings with the Patent Office he attributed to Suess et al. everything that his clients had theretofore publicly attributed to Schwarz.

(iii) *"In contrast to the earlier schemes, * * * the Austrians employed an oxygen jet of more moderate force, so that the oxygen jet did not penetrate so deeply into the bath" (Op. pp. 6-7). This stems from 257 F.Supp. at 400.*

The chart comparing the depth of penetration under the conditions stated in Miles, and the depth of penetration under the Rinesch version of Miles, with the depth of penetration in the *commercial example* of the Suess

patent (DX-213; App. A:429a) was not before the *McLouth* Courts. There is and can be no dispute over its accuracy. It shows that Suess commercially employed an oxygen jet of greater force than Schwarz/Miles employed and that the Suess jet penetrates *more* deeply into the bath.

The "avoid deep penetration" assertions made by Rinesch and Hauttmann are hearsay as to this defendant because the affiants were never made available for cross-examination; *Jerrold Electronics Corp. v. Wescoast Broadcasting Co.*, (C.A. 9, 1965) 341 F.2d 653, 666; *Richardson v. Campbell*, (W.D. Pa., 1896) 72 Fed. 525, 528.

(iv) "* * * *the multi-faceted physical-chemical Suess process" (Op. p. 7).*

This characterization stems from the lower court's opinion (I:73, 185, 242).

Suess contributed nothing unique; the prior art is precisely the same "multi-faceted physical-chemical process". The description of these phenomena in "Oxygen Steel" (DX-1; App. A:304a, at 310a) is far more detailed than in the Suess patent, and plaintiffs admit, in Oxygen Steel that all of them hold good "*even on deep penetration*".

— III —

It is thus apparent that the Opinion is internally inconsistent, in that in Part A and Part B the Opinion *prima facie* appears to state as established facts that Suess is the "fundamental" patent, that the prior art was never exploited commercially, that the Austrians avoided deep penetration and that they originated a

unique multi-faceted physical-chemical process; while in the succeeding portions of the Opinion the Court documents every statement to the *McLouth* proceedings and, moreover, is careful to say that it neither agrees nor disagrees with the conclusions of the *McLouth* Courts on the merits of the Suess patent, reverses the lower court solely on the ground of collateral estoppel and directs the lower court to dismiss the complaint on that ground alone.

— IV —

Apart from the matter of internal inconsistency above noted, we think the inclusion of the amplifying language requested by this Motion is important for these reasons:

(1) Plaintiffs' counsel have given notice, via a letter to the Clerk dated April 7, 1975, of their intention to petition for a writ of certiorari. It would be unfair to this Court and to defendant as well if they are left in position to say that both this Court and the *McLouth* Courts have found that the Suess patent is fundamental to oxygen steelmaking as commercially practiced.

(2) Assuming that the plaintiffs wi'l be unsuccessful in their attempts to upset this Court ı decision, and that the Judgment entered April 4, 197 . becomes the Mandate; Rule 41, F.R.App.Proc.; defen ant will then have the right to pursue its counterclaims and its prayer for attorney fees; *Beckman Instruments, Inc. v. Chemtronics, Inc.,* (C.A. 5, 1970) 430 F.2d 1369, 1381 (reversing W.D. Texas, 1968; 160 USPQ 619, 622); cert. den. (1970) 400 U.S. 956, reh. den. (1971) 400 U.S. 1025.

Defendant expects to proceed thus; and we think it highly probable that the defendants in some or all of the

other pending cases, notably those, who like J&L, have been put to enormous expense in preparation for the defense of their cases, will do the same.

The Court states (Op. p. 5) that it "need not address the other contentions presented, such as the patent's validity * * *". All that is sought by this Motion is a clarification of the Opinion which will make it clear to all concerned that nothing said in the Opinion speaks more broadly.

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*Appendix.*

**Excerpts From German Patent No. 735,196 Published July 3, 1943, Issued To H. A. Brassert & Co. Of Berlin-Charlottenburg: Inventor Dr. Carl Schwarz Of Berlin [DX-5-A]**

The object of the present invention is a method of bringing gases into particularly intimate contact with liquid baths, for instance metal baths, by providing the jet of gas directed onto the surface of the bath with such a high kinetic energy that it is capable of penetrating in the manner of a solid body deep into the bath by the use of extremely high velocities lying preferably above the speed of sound.

* * * * * * *

In the refining of steel with oxygen-enriched air or oxygen, when using the method in accordance with the invention, the danger of rapid wear of the container liner is eliminated since the reaction between oxygen and iron or iron-accompanying substances with the phenomena resulting therefrom, namely local overheating and accumulation of ferrous oxide, takes place in the center of the steel bath and therefore the walls of the vessel are not substantially attacked.

*Appendix.*

**Excerpt From "One Year L-D", Published By Voest In 1953 [DX-174]**

The principle thought that it would be correct to utilize uniformly all knowledges, experiences and patents on oxygen refining, so that it can be avoided, that one single patent holder is played off against the other, lead to the decision to find a converting company for the use of the LD-process outside of Austria.—The head office of this company is situated in Zürich, Switzerland, and it is called "BOT" —Brassert Oxygen Technik A. G.—"BOT" has the exclusive privilege of using the most important groups of patents, at the present existing for the oxygen blown steel process and which are of technical importance for this process.

These are besides the VOEST patents (23 in Austria, 114 in Foreign Countries), patents of OAMG (25 in Austria, 94 in Foreign Countries) and patents of the Brassert Group (20 in Foreign Countries) of which the Schwarz patent and the Miles patents (12 abroad) have been mentioned before. Patents and findings of Mannesmann Company, Huckingen, also are included in this uniformed conversion by contracts.

*Appendix.*

**Excerpts From Confidential Memorandum Of BOT To Kaiser [DX-7]**

However, it has been confirmed in numerous experiments that for operational and qualitative reasons it is not possible—at least not in continuous operation—to refine iron with pure oxygen, if the classical converter design using a tuyere bottom for the introduction of the refining agent is adhered to. Therefore a fundamentally new idea, that of refining the iron by blowing oxygen *upon* the bath surface, had to be realized. This all-important idea has already been patented on our behalf by DRP No. 735.196. [p. 2]

* * * * * * *

The fundamental basis of the oxygen steelmaking process is presented by the invention of Professor Dr. C. Schwarz; it was registered as German patent No. 735.196 on behalf of the patentee—the firm Brassert Co. of Berlin-Charlottenburg. This invention for the first time points out a method by which, in practical operation, steelmaking iron can be refined by direct reaction with pure oxygen. According to the invention, a jet of oxygen should be blown against the surface of the molten metal contained in a vessel of suitable shape (converter). [pp. 26-7]

*Appendix.*

**Excerpts From "Oxygen Steelmaking in the United States" Published By Kaiser In September, 1954 [DX-177-A]**

The acquisition of the United States license for the Oxygen Converter Process from Brassert Oxygen Technik A. G., Zurich, Switzerland, has brought Kaiser Engineers into partnership with member firms throughout the world who have developed this new steel-making process. These firms include H. A. Brassert & Company of Berlin-Charlottenburg, holder of the basic Schwarz patent, and the Austrian plants at Linz (VOEST) and Donawitz (OAM).

* * * * * * *

The earliest efforts employing the use of oxygen in the refining of molten pig iron to steel appeared among the experiments of Henry Bessemer while he was developing his air-blown converter. These and later experiments were directed toward the reduction of nitrogen in the refined steel by oxygen enrichment of the air blast. For 75 years these attempts remained unsuccessful, because high purity oxygen was not available in the tonnages required by the steelmaking industries and also because oxygen enriched air blown through the bottom of the Bessemer converter inevitably resulted in localized high bath temperatures which created an insoluable refractory problem.

The production of oxygen in tonnage quantities was solved by Linde at the turn of the century when he perfected his basic cycle for the liquefaction of air. But the cost remained high and was not

brought within commercial range until about 1925 when Fraenkl suggested the use of regenerators in the Linde cycle.

With the cost problem of oxygen availability resolved, the German Steel Institute in 1937 initiated experiments under the direction of Dr. Karl Schwarz which broke down the barriers against the use of oxygen in the Bessemer converter. The problem was solved through the expedient of impinging a jet of high velocity high purity oxygen on the surface of a molten bath contained in the converter vessel. The results were encouraging. Steel thus made met every metallurgical test while retaining the high tonnage low cost benefits of the conventional Bessemer converter. From Germany the new process was taken to Austria where full scale commercial installations were made at Linz and Donawitz. These installations have been functioning with the highest degree of success since their completion in 1952. At Huckingen, Germany the Mannesmann-Huettenwerke later established a converter which, in contrast to the Austrian plants, refines a pig iron high in phosphorous.

*Appendix.*

**Excerpts From Specifications Of Miles British Patent 642,084, Published Aug. 30, 1950 [DX-8]**

According to the invention there is provided a process for the refining of metals in which air or other oxygen-containing fluid is projected into a bath of the fluid metal at a velocity sufficient to ensure that substantially no fluid is reflected at the surface of the bath [p. 1, col. 1]

* * * * * * *

The air, oxygen, or other fluid may be for example projected downwardly on to the surface of the molten metal to be treated with such a velocity that the jet of fluid penetrates the bath as if it were a solid rod. [p. 1, col. 1]

* * * * * * *

The high velocity of the jet of fluid ensures that the source of the oxidising chemical reactions occurs inside the bath well away from the refractory lining of the furnace. [p. 1, col. 2]

* * * * * * *

It has been found for example, that when using a gaseous mixture a nozzle of 0.32 inches internal diameter, the nose of which is 6 inches above the surface of a bath of molten pig iron needs a gas pressure of 7 or 8 atmospheres in order to deliver about 10,000 cubic feet of gas per hour towards the metal with a velocity of not less than 1250 ft./sec., such velocity being obtained by suitable design of the nozzle. Velocities of this order are desirable

in order to obtain the optimum penetration and effect by the fluid. Lower velocities may be used with correspondingly greater losses of oxygen, but for gaseous mixtures the pressure should be not less than 50 pounds per square inch. [p. 8, cols. 1-2]

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*Appendix.*

**Excerpt From Agreed Translation Of Article By Robert Durrer "Refining With Oxygen in Gerlafingen" Published In Von Roll News, May, 1948 [DX-163-B]**

Oxidizing (refining) with iron oxides or blast has considerable disadvantages which as a rule can be eliminated if undiluted or concentrated oxygen is used. Smelting and refining with pure oxygen or with oxygen-enriched air will modify iron recovery decisively, and leading iron producing countries have already begun to tackle this problem with great energy. Although in our small country there are only limited means available for the development of this new processing method, we nevertheless attempt to utilize it as best possible. With this consideration in mind, necessary preparations are in course in our Gerlafingen plant, and on the first day of spring, Dr. Heinrich Hellbrugge, our "oxygen man" has conducted the first test, and thus pig iron was refined to steel with undiluted oxygen (oxygen-refining) for the first time in Switzerland. The purpose of this test was merely to determine the suitability of the equipment and procedure in principle on an operational basis, since this process had already been carried out successfully years ago on a small scale. This test, conducted with somewhat over one ton, was the first practical step made in Switzerland on a road certainly full of thorns, the objective being to acquire more advantageous iron recovery in our country, and also, to contribute our modest share in advancement of the iron recovery of the world.

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On Saturday, April 3, 1948, some further blowing (blasting) tests were conducted with success, and among other things, the noteworthy result was that over one half of the weight of the pig iron could be added in the form of cold scrap. That is to say that for one ton of pig iron with about 1.5 per cent Si and less than 0.1 per cent P content, half a ton of scrap can be added which is melted by the heat produced during the blowing.

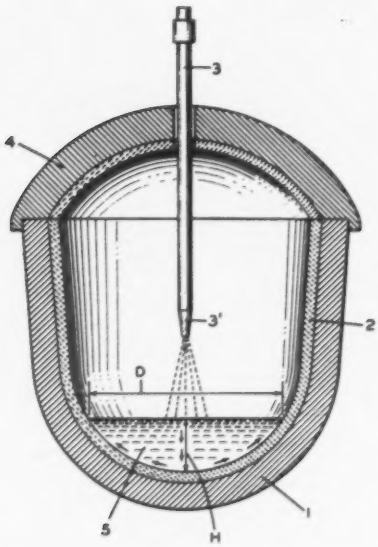
Photograph of the Gerlafingen Converter
in Operation, from Von Roll News [DX-163-B]

*Appendix.*

April 10, 1956 O. CUSCOLECA ET AL 2,741,555

PROCESS FOR REFINING PIG IRON

Filed Nov. 25, 1955

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*Appendix.*


# United States Patent Office

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2,741,555

## PROCESS FOR REFINING PIG IRON


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Application November 25, 1953, Serial No. 849,140

Claims priority, application Austria March 17, 1951

6 Claims. (Cl. 75—52)


The invention relates to a process for refining pig iron in a converter or other suitable vessel, in which oxygen or other oxidizing gases or oxygen-containing gas mixtures are blown against the bath surface from above and the heat quantity required for the process is produced by the reaction of the oxygen with the impurities in the molten pig iron bath.

More particularly, the invention relates to a new process for refining primarily hot ferrous metal charges, for example, predominantly molten pig iron, with a jet of high purity gaseous oxygen directed downwardly through the slag cover onto the surface of the molten metal bath, generally at the central portion thereof, to produce steel at least equal in quality to basic open hearth steel, particularly with reference to nitrogen, oxygen and phosphorus content. The heat required for the refining is autogenous, being produced primarily by reaction of the oxygen gas with the impurities in the molten pig iron.

Processes for surface blowing with air or oxygen have been suggested previously as a possibility of refining primarily hot metal charges.

In the well-known Tropenas converter utilized in foundries, and suitable only for blowing relatively small metal charges, the air is blown onto the surface of the metal in an acid lined converter through tuyeres positioned above the melt level. In such a process, a large quantity of the heat developed is produced by combustion of the evolved carbon monoxide to carbon dioxide within the vessel. Thus, the Tropenas converter produced a much hotter blown metal from a charge of similar composition than can be attained in the bottom blown Bessemer converter, but this is necessarily at the expense of the oxygen efficiency in terms of total oxygen input compared to the theoretical oxygen consumption required in the refining reactions. It has been demonstrated that this burning of the carbon monoxide to carbon dioxide within the converter is caused by the high amount of available oxygen in the converter free space due to the low angle of inclination or impingement of the air jets on the melt surface.

When oxygen enriched air or oxygen is substituted for ordinary air in the above-mentioned type of surface blown process, it has been demonstrated that the low angle of impingement of the jet upon the melt surface produces excessively high temperatures above and at the melt-slag interface on the side of the vessel opposite the tuyeres or oxygen inlet so that a substantially rapid deterioration of refractory occurs. In addition, with an oxygen jet, the loss in oxygen efficiency due to this deflection of the gas from the melt surface cannot be tolerated, and further, the increase in temperature due to burning of a relatively large proportion (40 to 50 percent) of the evolved carbon monoxide to carbon dioxide above the melt is undesirable in further contributing to the short refractory life. The heat produced by the oxygen-molten metal reaction is more than sufficient to provide the necessary heat for completion of the refining reactions to the desired steel analysis, and for teeming.



In still other proposed surface blowing processes, intensive mixing of the oxygen jet and the molten metal has been deemed imperative. Thus, a supersonic velocity of the oxygen jet was proposed so that the jet would impinge upon the melt surface with such an impact energy that the jet would deeply penetrate the molten pig iron bath. As a result of such process, the high temperature oxygen-pig iron reactions were essentially uncontrolled, and proceeded at velocities which induced excessive temperatures and lack of control over the refining process in general so that over-oxidation of the blow metal resulted. In addition, the refractory bottom of the refining vessel was subject to rapid deterioration.

Attempts to bottom blow with high purity oxygen resulted in destruction of the refractory bottom in one heat. Accordingly, the invention is directed to an economical, commercially feasible process for refining primarily hot metal charges with high purity oxygen capable of producing a refined steel at least equal in quality to that produced by the well known basic open-hearth process from pig iron of widely varying chemical composition.

It is accordingly a primary purpose and object of this invention to provide a process for the refining of primarily hot metal charges, that is, predominantly molten pig iron, with high purity gaseous oxygen in which controlled refining at substantially theoretical oxygen efficiency is accomplished.

A further object is to provide a process for refining of molten pig iron with a surface blown high purity oxygen jet in which an exceptionally high refractory life is obtained.

The invention also has as its object to provide a process of surface blowing molten pig iron with high purity oxygen in which the refining reactions and oxygen impingement on the melt surface are controlled in a manner such that over-oxidation of the melt is essentially avoided.

It is still another object of the invention to provide a high purity oxygen refining process which is applicable to pig iron of widely varying chemical compositions, including in particular pig iron of analyses used in ordinary basic open-hearth practice, as well as those of higher silicon and phosphorus contents required for blowing in the acid Bessemer and basic Thomas converter processes to produce steels having analyses and qualities at least comparable to that of basic open-hearth steels. Another object of the invention is to provide a high purity oxygen refining process for production of steel of excellent quality at a high rate of production, substantially comparable to Bessemer or Thomas converter practice, for example, a blowing time of from 15 to 25 minutes for charges of from 30 to 40 tons to carbon end points of 0.05 percent or below. These and other objects and advantages of the invention will be apparent from the following detailed description of the process.

The process of the invention generally comprises refining the molten pig iron metal in a converter-type or other suitable vessel with a high purity oxygen jet impinging on the melt surface, preferably at the central portion thereof, from directly above by means of a blast nozzle, or other suitable gas jet-producing means, under controlled conditions of jet impact pressure, hereinafter defined, to supply to the molten metal the required amount of oxygen for refining to the desired steel analysis, and to produce autogenous heat sufficient to insure completion of the refining and adequate temperature in the refined charge for subsequent handling.

The invention realizes the foregoing objects and other advantages, and in particular the avoidance of an oversupply of oxygen by an intentional limitation of the energy of the jet impinging on the bath surface, and essentially resides in that the pressure of the blast jet on a surface having from the blast nozzle a distance equal

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to the distance of the bath surface from the blast nozzle is kept below 0.75 kg./sq. cm., (about 10.5 p. s. i.), preferably below 0.5 kg./sq. cm., (about 7 p. s. i.).

The foregoing expression for pressure measurement refers to the average impact pressure of the blast jet measured on a reference surface outside of the converter with the blast nozzle spaced from the reference surface at a distance equal to the spacing of the blast nozzle from the molten metal bath surface under operating conditions in the refining vessel. It is to be understood that the actual impact pressure of the oxygen jet upon the molten metal bath surface is not necessarily equal to the impact pressure measured on the reference surface. This expression, however, empirically determined, fully defines the limit to be observed on the impingement pressure of the oxygen jet on the bath surface for any given spacing of the blast nozzle, nozzle design, oxygen pressure at the blast nozzle and nozzle orifice diameter utilized in the process for supplying the calculated volume of oxygen at the rate required to complete the refining process within the predetermined time period. This expression eliminates the necessity of defining the characteristics of the oxygen jet in terms of factors which may be substantially varied, such as the aforementioned nozzle design, nozzle orifice diameter, and oxygen pressure at the nozzle, changes of which within rather wide limits are permissible, while still maintaining the impact pressure of the jet within the limit above-defined, and supplying the requisite quantity of oxygen to the molten metal charge at the proper rate.

The invention is based on the recognition that to ensure a perfect development of the reaction it is not necessary at all to conduct the blast jet against the bath with a kinetic energy so high that the blast penetrates deeply into the bath, but that it is sufficient when the blast contacts the bare metal surface of the bath to enable the oxygen to react with the metal. When a slag cover is utilized, the slag layer must be initially displaced or penetrated in the area of impingement. This is normally accomplished by the oxygen jet itself, and this function sets the lower limit for the energy of the oxygen jet, which may be as low as 0.75 pound per square inch (about 0.05 kg./sq. cm.). Where other means than the oxygen jet are employed for initial slag displacement impact pressures as low as about 0.28 pound per square inch (about 0.02 kg./sq. cm.) may be used, although this protracts the blowing time. The upper limit for the energy of the oxygen jet, however, is set thereby that the blast should not, or at least not deeply, penetrate into the metal bath, because it has been found by exhaustive tests that a deep penetration of the blast into the bath causes an oversupply of oxygen impairing the quality of the steel being produced, or causing excessive refractory wear on the refractory bottom. Thus, in accordance with the invention, the velocity of the jet impinging on the bath surface should be determined approximately in correspondence with the velocity of the reaction of the oxygen with the bath so that the oxygen required for the reaction is available whereas an oversupply of oxygen is avoided. It has been found that these conditions are fulfilled if the surface pressure of the blast jet on the bath surface is such that it corresponds to an impact pressure below 0.75 kg./sq. cm., preferably below 0.5 kg./sq. cm., measured on the reference surface outside of the converter at equal spacing of the blast nozzle, as set forth above. By conducting the blast process in accordance with the invention a subsequent treatment of the bath, to improve the quality, such as addition of ferromanganese, is generally rendered superfluous, with resulting savings in expense and time. The action of the jet on the bath surface is determined by the shape of the blast jet, by the distance of the nozzle from the blast surface, and by the velocity with which the jet escapes from the nozzle. Where the blast nozzle consists of a Laval nozzle (venturi-shaped), the nozzle velocity of the jet may



be increased within wide limits beyond the velocity of sound. However, this is not necessary at all for the process according to the invention. The velocity of sound, however, is reached in most cases without any special shaping of the nozzle. An ordinary nozzle or lance of straight line configuration may be utilized.

Suitable means for water cooling the lance or blast nozzle is provided since it is exposed to the high temperature existing within the refining vessel.

In accordance with the invention the jet may be conducted against the bath surface in the shape of a cone, the diameter of which at the level of the quiet bath surface is at least three times, suitably at least five times the orifice diameter of the nozzle. With such a ratio between the diameters, the condition can be fulfilled that the blast jet enters into reaction with the bath without substantially deeply penetrating into it.

The limitation of the energy of the blast jet impinging on the bath surface may be achieved by increasing the distance of the blast nozzle from the bath surface. In accordance with the invention the blast nozzle may be arranged so that the distance of its orifice from the bath surface when quiet is at least 150 mm. (about 6 inches), and not substantially in excess of 2000 mm. (about 80 inches), and preferably above 250 mm. (about 10 inches), through the operating ranges of nozzle pressures of from about 3 to 20 atmospheres and nozzle sizes the area of the smallest interior nozzle opening being selected to provide 32 square millimeters (about 0.5 square inch) per metric ton of metallic charge. By this measure it becomes possible to blow the gas at a higher velocity without exceeding the surface pressure on the bath surface beyond 0.75 kg./sq. cm. or 0.5 kg./sq. cm. Therefore, the nozzle cross section may be smaller so that smaller quantities of cooling water are sufficient for the nozzle, while the flow of gas is maintained at the same rate. Thereby, on the one hand, the cooling of the nozzle is facilitated because the quantity of cooling water is reduced, and on the other hand, owing to the larger nozzle spacing from the bath surface a smaller cooling effect is required because the nozzle is highly protected already by its larger distance from the bath surface. Tests have shown that in contradistinction to the previous assumptions the converter lining above the bath surface is not excessively affected even with such nozzle distance and that a fully sufficient action of the blast jet on the bath surface appears to be assured without involving increased losses of the oxidizing gases. In exemplary commercial practices with thirty ton converters utilizing oxygen pressures of about 8 to 10 atmospheres and nozzle diameters of from about 27.5 to 40 mm. (1.1 to 1.6 inches), nozzle spacings varying from 25 to 60 inches (about 650 to 1500 mm.) have been used, the preferred spacing being from 30 to 50 inches (about 750 to 1250 mm.). In general, it may be stated that as the oxygen pressure and nozzle diameter are increased, nozzle spacing is increased.

Since oxygen has a very high affinity to iron, the contact of oxygen with the bath causes a rapid combination of oxygen and iron to form FeO, part of which goes to the slag and part enters the bath by diffusion. The elements accompanying iron, that is, silicon, manganese and phosphorus, are also oxidized, whereby the bath is intensively warmed, temperatures in the direct oxidation reaction zone approaching the boiling point of iron. Subsequently the FeO formed reacts with carbon to form CO and the formation of CO causes a strong agitation of the bath by which unrefined metal is continuously presented to the oxygen gas reaction zone, and a slag-metal emulsion is formed. The stream of oxygen contacts the emulsion of bath and slag components so that the reactions are distributed over a large surface of iron and are accelerated. By the formation of the emulsion having a large surface, the rapid progress of the process is enabled though the jet blast does not penetrate deeply into the metal bath.

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and the initially high FeO content of the slag is rapidly diminished.

Owing to the high affinity of oxygen with iron and the elements accompanying it in the pig, the jet blast conducted in the manner according to the invention consumes by performing its oxidizing work before it can deeply penetrate into the metal bath. By the formation of the oxides, extremely high temperatures are generated locally. The reactions taking place at these high temperatures have not been definitely explained yet scientifically. Tests have shown that at the beginning of the blast process a combustion of iron takes place to form FeO. The emulsion is not formed at the beginning of the blast process; this can be shown by the fact that the bath level initially does not rise, although a short visible flame is formed immediately after start of blowing. The emulsion will be formed only when with rising temperatures the rapid combustion of carbon starts, usually about the second or third minute with starting of the carbon boil. Only from this time will the rapid development of the entire process begin. An oversupply of oxygen, therefore, will have adverse effects primarily during the further development and in the final phases of the blast process because on the one hand the bath surface available for the reaction will not have been increased before by the formation of the emulsion, and because on the other hand any overoxidation of the bath taking place only initially may be compensated to the highest possible degree during the later stages of the blasting. Therefore, in accordance with the invention, it is possible, if desired, to start the reaction between the oxygen of the blast jet and the bath vigorously and to reduce only subsequently the energy of the blast jet so that the surface pressure of the blast jet on the bath surface will correspond to an impact pressure on the reference surface below 0.75 kg./sq. cm. or below 0.5 kg./sq. cm., as set forth above.

The advantages of high oxygen efficiency and high refractory life are obtainable according to the process of the invention when the oxygen jet impinges on the central portion of the bath surface from directly above, that is, approximately vertically with specific surface pressures, as above set forth. Oxygen efficiencies calculated on the basis of total oxygen input compared to oxygen consumed in the bath reactions is approximately 95 percent. This is demonstrated by an average high purity oxygen consumption, when refining pig iron of basic open hearth analysis of only 57 normal cubic meters (measured at standard conditions of temperature and pressure) per ton of ingots including oxygen consumption for heating the converters after relining. This compared with calculated or theoretical oxygen requirements for the refining of the various pig irons blown to steel analyses set forth below represents about a 95 percent efficient utilization of oxygen. In addition, analyses of waste gases effluent from the converter indicate that the carbon in the instant process burns almost 100 percent to carbon monoxide, the analyses showing on the average over 90 percent CO and less than 10 percent $CO_2$, indicating that the oxygen input is not lost by burning with the carbon monoxide above the melt within the refining vessel, as in the case of low angle impingement. Moreover, this is a distinct advantage in the instant process, since the reaction of the oxygen with the melt provides more than sufficient heat for the refining, and additional heat by burning of the carbon monoxide to carbon dioxide above the melt is to be avoided. The potential heat units in the effluent carbon monoxide may be utilized in various ways by subsequent burning.

In conducting the process in the manner set forth above, the zone of direct oxygen reaction is effectively confined to the central portion of the bath, and the endothermic reduction of FeO by carbon to form CO encompasses this zone affording protection to the vessel lining. In this regard, the blowing conditions are maintained such that the diameter of the area of jet impingement is at least



one twenty-fifth of the total bath surface diameter, and preferably one tenth, while it should not substantially exceed about one fifth. When operating within the limits of surface pressure set forth above, preferably a diameter of the impingement area of about one tenth the bath surface diameter should be observed. Thus, exceptionally high refractory life is obtained at high production rates. For example, in refining of pig iron having the following chemical composition: carbon 3.8–4.2, silicon 0.6–1.3, manganese 1.4–2.2, phosphorus 0.120–0.250, and sulfur 0.045 max., and a slag having the following composition $SiO_2$ 12–17 percent, CaO 38–44 percent, MgO 5–10 percent, MnO 9–13 per cent, $P_2O_5$ 1.2–1.8 percent, and Fe 12–17 percent, in a 30 ton converter, the average durability of the refractory is over 200 heats (foregoing in percentages by weight). By comparison, in basic Bessemer practice, the removable converter bottom must be relined after only 35 to 60 heats. In addition, the refractory life obtainable by the process of the invention surpasses that obtained in normally operated open-hearth practice in that in refining of a normal charge by basic open-hearth about 36 lbs. of refractory brick is consumed per ton of steel produced to which must be added some 40 pounds of sintered dolomite for fettling operations, whereas total refractory consumption in the instant process is only about 24 lbs. per ton of steel produced, or less.

The process has as one of its major advantages the applicability to pig iron of analyses used in ordinary open-hearth practice, for example, within the composition limits above set forth, which would not be amenable to refining by either the acid Bessemer process due to the phosphorus content, or the basic Thomas process due to the lack of sufficient phosphorus. In addition, the process is fully applicable to pig irons having analyses of the type which are normally utilized either by the acid Bessemer (high silicon-low phosphorus) or the basic Thomas converter processes (high phosphorus).

In the usual operation of the process, it is preferred to employ oxygen of a purity of at least 98 percent (by volume), preferably above, since this results in negligible nitrogen pick-up in the metal bath as shown by frequency curves based on the produced steel analyses indicating a peak or maximum at a nitrogen content of from 0.002 to 0.003 percent, with 95 percent of all heats blown showing a nitrogen content of 0.004 percent or less.

In addition to the low nitrogen contents, the steel produced is characterized by its high purity with respect to the undesired elements phosphorus, sulfur, and oxygen.

In application of the process to basic refining, the effective heating of the slag cover and metal bath from above, the FeO formed initially absorbed into the slag, and the boiling action setting in at an early stage of the process, are highly beneficial in that they promote the formation of an early fluid and highly oxidizing slag relatively high in reactive lime. This condition provides an accelerated rate of phosphorus and sulfur removal from the bath, leaving the steel very low in both elements. With normal open hearth pig irons having phosphorus contents ranging from about 0.1–0.35 per cent, and with correct lime additions, final phosphorus contents not higher than about 0.025 percent, and as low as 0.010 percent are obtained at the time the carbon end point is reached with a single slagging operation. With sulfur contents in the pig iron of from 0.045 to 0.08 per cent, the sulfur content is decreased to 0.2–0.025 per cent, and on the lower range of sulfur in pig iron to values as low as 0.012 percent.

In addition, the process has proven itself capable of removal of phosphorus to well below 0.05 percent at the desired carbon end point on basic Bessemer pig iron having phosphorus contents from 1.5 to about 2 percent.

The vigorous boil, above-mentioned, continues up to the carbon end point, and together with the induced circulation of the bath metal toward and away from the central zone of direct oxygen reaction, effectively counteracts any tendency to over-oxidation of the bath. When the

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flame dies and carbon combustion is completed, the bath becomes relatively quiet and intimate contact between slag and metal bath ceases. The turbulence of the bath and slag due to the low impact pressure of the oxygen stream impinging from directly above is insufficient to cause continuance of oxygen-metal reactions. As a result, steels blown by the process of the invention do not suffer from the deteriorating effects of high oxygen (FeO) contents. Direct oxygen determination by the hot extraction method yielded oxygen contents of 0.04 percent maximum for heats that were blown to a carbon end point of from 0.05 to 0.10 percent C. Thus, the oxygen content of steels produced by the high purity oxygen blowing process compare very favorably with oxygen contents of basic open hearth steel in the same carbon range, and are definitely lower in oxygen content than bottom blown Bessemer steels using air, oxygen enriched air, oxygen and steam, or other gas mixture.

Regarding scrap additions, the process advantageously may utilize scrap charges of up to 30 percent, depending primarily upon the silicon content of the pig iron and the temperature of the hot metal. For lower ranges of silicon, such as 0.6 to 0.7 percent, scrap charges of 12 to 18 percent are permissible. With silicon in amounts from 1 to 1.2 percent, scrap charges of 20 to 25 percent may be utilized.

In the normal range of phosphorus in basic open hearth pig iron of about 0.1 to 0.35 per cent, the required slag volume with from 3 to 8 percent lime charge is advantageously much lower than the slag volume in the bottom blown basic Thomas process. The iron content of the slag ranges between about 9 to 17 percent. On high phosphorus pig iron of the basic Bessemer type, due to the required increase in slag volume, the total iron content lost to the slag may be increased when blowing to a low phosphorus percentage of 0.015–0.02 percent. Thus, in treating "steel making" pig iron, i. e. pig iron of basic open hearth analysis, the slag volume amounts to only from 8 to 16 percent and averages 14 percent iron. Consequently, the iron loss does not exceed normal values, for example only about 2 percent per ton of steel.

In regard to output, the combustion of the impurities of "steel making" pig iron and the iron content of the slag total a loss of about 8.0 percent with an additional 0.8 percent of iron lost in the dust fume from the process. With mechanical losses averaging about 0.8%, the percentage recovery of the refining process is approximately 90 percent comparable to the yield with the basic open hearth process.

While observing the limits of impact pressure of the jet upon the melt surface, as above set forth, the oxygen flow rate in the process is maintained to provide an average such that blowing is completed and the carbon end point reached within a time period of from 12 to about 30 minutes, preferably 17 to 20 minutes, depending, of course, upon the particular pig iron charge, scrap to hot metal proportions, and the specific steel analysis to which the metal is blown.

The accompanying drawing diagrammatically illustrates a device for carrying out the process of the present invention. A converter type vessel with a closed bottom is shown having a metallic wall 1 and a refractory lining 2. An oxygen supply lance 3 is inserted through an opening of the cover 4 of the refining vessel. The lance is centrally positioned and overhung above the charge, being provided with a nozzle 3' for directing a jet of oxygen gas onto the surface of the charge. The molten material charge is indicated at S, the depth and diameter of the surface of the molten material being denoted by H and D, respectively.

The following is a detailed description of a typical operation of the process, which is not to be regarded as a limitation on the invention, but rather as a complete specific embodiment thereof.



*Example 1*

A converter of symmetrical design with a centrally located mouth, through which gases are passed directly into a stack and provided with a removable bottom is utilized, the outside diameter of the converter being about 14 feet and overall height of about 20 feet. The converter provides bath dimensions of about 8½ feet inside diameter having a bath area of approximately 57 square feet, and a bath depth of about 3 feet. An overhung movable water cooled oxygen lance is connected to a high purity oxygen plant, producing oxygen of 99 percent purity, through an oxygen accumulator and an oxygen supply line in which a pressure reducing valve of usual type is inserted, the pressure prevailing in the said accumulator being about 955 p. s. i. In operation, the lance is inserted through the centrally located converter mouth to the adjusted distance above the surface of the charge after initial charging. As set forth below, the typical cycle of operations from charging to teeming is given on a time table basis.

| Time, Hours | |
|---|---|
| 11.30 | 2,400 kg. plant returns scrap charged to converter. |
| 11.30 | 30,400 kg. hot metal charged having the following analysis: 3.75% C, 1.90% Mn, 0.15% Si, 0.05% S, 0.05% P, 0.005% H, about 0.01% N. |
| 11.45 | Addition of 1,500 kg. burned lime, 500 kg. mill scale and 500 kg. fire-clay bats. This material was charged from the rail side through a removable gravity chute with the converter tilted to the charging bay side. |
| 11.45 | Positioning of jet nozzle, blowing commenced at a nozzle pressure of 138 p. s. i. (which means the pressure prevailing between the pressure reducing valve and the nozzle), with a nozzle diameter of 1.10 inches, and a nozzle spacing from the bath of 81.3 inches (206 millimeters). Within three-tenths of a minute the oxygen was ignited, and a flame of 1 to 2 meters was projected over the converter mouth. At the end of about one minute the flame was elongated to about 7 meters. |
| 11.55 | After 10 minutes of blowing time, the nozzle pressure was reduced to 114 p. s. i. |
| 12.05 | The converter flame became transparent, the oxygen jet nozzle was retracted and the oxygen flow shut off to end the blow in 20 minutes. |
| 12.05 | The converter was tipped to the horizontal, sampled, and slag condition noted as well as fluid. |
| 12.07 to 12.14 | About three quarters of the slag was allowed to run into a slag thimble, the remaining slag was stiffened by addition of about 30 shovelfuls of burned lime through the converter mouth. |
| 12.15 | Teeming of the heats after adding 3 kgs. of aluminum, the teeming temperature being 2,886° F. A group of four ingots of about 0.5 tons (metric) was cast. Ingot teeming temperature measured 2,886° F. and the yield in rolled ingot steel was 88.1% having a composition as follows: 0.07% C, 0.27% Mn, 0.0% Si, 0.016% P, 0.020% S, 0.002% N. |

Total oxygen input was 1297 cubic meters measured at standard conditions, compared to the theoretical oxygen requirement for the pig iron analysis, scrap charged, and the analysis of finished steel obtained calculated at 1212 cubic meters (measured at standard conditions). This indicates an oxygen efficiency of 93.4%.

In the foregoing example, the nozzle pressure, nozzle orifice diameter and nozzle spacing provided an impact pressure of the oxygen jet on the melt surface such that the impact pressure of the jet measured on a reference surface outside the converter was 0.184 and 0.164, respectively kilograms per square centimeter (2.62 and 2.42 p. s. i., respectively) utilizing the same nozzle spacing, nozzle pressure and nozzle orifice diameters.

In this as well as in all other cases in which impact pressure is referred to in this application the following method of measurement is used to determine the average impact pressure:

To determine the average impact pressure the first step consists in measuring outside the converter the diameter of the unobstructed jet emerging into air at such a distance from the nozzle orifice as is equal to the distance of

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the metal bath surface in the converter from the nozzle orifice during operation. In Example 1 this distance is 31.5 inches (about 800 mm.). To perform this measurement a Pitot tube such as is conventionally used for aerodynamical measurement: is moved in a plane normal to the jet axis. If a nozzle having a circular cross-section is used the Pitot tube is moved on two straight lines which intersect the jet axis at right angles to each other. The resulting pressure pattern decreases from a maximum lying in the jet axis towards the boundaries of the jet. The boundary of the jet is considered to be disposed at those points where the pressure measured with the Pitot tube (Pitot pressure) is 1 mm. water column. This limiting value has been chosen because lower values cannot be measured with the required accuracy under practical conditions. The mean diametrical spacing of two pairs of diametrically opposite points having a Pitot pressure of 1 mm. water column will give the diameter of the jet at a given distance from the nozzle orifice. Using this diameter the cross-sectional area of the jet, considered as of circular cross section, at the respective point is calculated. This cross-sectional area of the jet is considered the impact area.

Then the total pressure exercised by the gas jet is determined as follows: The jet is blown against a plate having a diameter at least twice the jet diameter measured as described hereinbefore. The arrangement is such that the jet axis intersects the plate at the center and the jet axis is at an angle of 90 degrees to the plate. The plate is connected to a weighing device arranged to indicate the total pressure exercised by the gas jet on the plate. The jet axis extends vertically and the plane of measurement extends horizontally. To calculate the pressure exercised by the blast jet on this surface, whose spacing from the nozzle corresponds to the distance of the nozzle from the quiescent bath surface when the nozzle is in operating position, the measured total pressure on the plate (in kg.) is divided by the area (in sq. cm.) of the jet cross-section measured in this manner. According to the invention the pressure thus calculated should be in any case less than 0.75 kg./sq. cm. (about 10.5 p. s. i.).

If another than a circular nozzle cross-section is chosen the same method of measurement is employed. In that case, however, it is not sufficient, to scan two mutually orthogonal straight lines in the plane of measurement with the Pitot tube but it is necessary to scan the jet cross-section in the plane of measurement around its entire periphery; the line where a Pitot pressure of 1 mm. water column prevails is considered the boundary of the jet cross section and of the impact area.

As will be seen, this impact pressure of the jet on the reference surface falls within the values set forth above. The oxygen nozzle pressure reduction during the latter portion of the blow reduces the oxygen feed rate and aids in low oxygen recovery in the steel by reducing oxygen input as the carbon boil nears completion.

### *Example 2*

The applicability of the process of the invention to grades of pig iron having analyses between that of typical basic open hearth and basic Bessemer iron is clearly shown by reference to the following steel production in which a hot metal charge analyzing as follows was blown under conditions similar to those set forth in Example 1: 3.61% C, 2.16% Mn, 0.46% Si, 0.856% P, 0.06% S. The blowing of this charge of rather unfavorable chemistry both with respect to normal open hearth practice and basic Bessemer yielded a steel having the following composition: 0.04% C, 0.15% Mn, 0.0% Si, 0.014% P, 0.04% S.

Steel produced by the process of the invention as above-described is comparable with, and in some applications superior to open hearth steel. As indicated above, this high purity oxygen blown steel has low phosphorus and sulfur contents, and its nitrogen content shows even lower average values than are found in open hearth steels. The metallurgical conditions, above described, eliminate excessive oxygen pick up by the bath during the refining period. An after-blow as in standard basic converter practice is, of course, not required, since the phosphorus is removed before the removal of carbon is completed. The boil period with carbon monoxide evolution, therefore, lasts up to the last minute of the refining period indicated by the flame drop and transparency, thus preventing an over-oxidation of the steel. This condition makes for low oxygen contents in the steel as blown, a fact which is indicated by the exceptionally good pourability of the steel without the aid of additions of manganese and by the absence of red shortness even at rather low carbon contents.

In the production of rimming steels, the high temperatures developed in the high purity oxygen blowing cause a manganese throwback from the slag into the metal bath as shown by a hump in the manganese curve for the latter portion of refining period. Manganese content does not thereafter decrease until carbon drops to its end point. Under such characteristics of comparatively high content of manganese in the finished heat, it is possible to pour rimming steels of relatively very low carbon contents without any additional manganese and deoxidizing agents. In addition, such rimming steels as produced by the process pour more easily than open hearth heats of identical manganese and carbon. Ingots are accordingly, relatively free from blow holes near the skin that would give rise to surface defects on blooms. Rimming ingots, as shown by test on four ton specimens, are characterized by uniformly good density and purity in the center and bottom parts of the ingot, the deviations from ladle analyses being limited mainly to the top 15% of the ingot. This compares more than favorably with open hearth steel ingots (4 ton) in which the phosphorus and sulfur content over the entire cross sectional area of the ingot deviated materially from the ladle analysis through the top ⅓ of the ingot.

The forming properties of the high purity oxygen blown steels should meet any requirement, as indicated by a large number of heats subjected to rolling in the hot strip mill. They stood up exceptionally well to rolling under normal shop conditions, the strip presenting perfectly smooth edges in the as-rolled condition with fine regularity. Testing for red shortness behavior yielded excellent results even in heats that were finished with a carbon content of 0.05% C and below.

The marked degree of cold formability of the high purity oxygen blown steels compares equally, and in some cases is superior, to those of open hearth steels. The rimming low carbon steels exhibit a low susceptibility to strain hardening, and accordingly exhibit excellent cold forming properties, which makes them particularly applicable for cold rolling, wire drawing and deep drawing. For example, production from heats of rimming low carbon steel of 0.08 max. carbon was subjected to drawing to reduce rods of 5.5 millimeters diameter down to 0.35–0.40 millimeters diameter with no intermediate anneal of stock being required. The cold work applied was 99.6%, a larger reduction than obtainable in open hearth steel under identical operating conditions.

The steels exhibit very favorable deep drawing properties, tests indicating the range of Erichsen—cupping—test values obtained from a large number of heats of cold and annealed strip to exhibit a lower limit well above accepted standard values. The deep drawing property of hot rolled and annealed high purity oxygen blown sheet steel is equally excellent.

The excellent characteristics of rimming steels produced by the present invention comparable to open hearth grades also permit production of high grade killed steels using silicon or other agents for deoxidation in the ladle.

28a

# *Appendix.*





The degree of purity as in the case of rimming steel, for killed high purity oxygen blown steel can meet the most exacting requirements. Results obtained from notch breaking tests in the blue shortness range from examination of step turned test pieces representing a large number of heats indicate that any degree of purity that might be specified for plain carbon high grade steels and high strength-structural steels can be met with the steel produced by the process of the invention. In regard to hot and cold forming properties, these killed steels are on a par with killed open hearth material. Regarding mechanical properties in the as-rolled and in the normalized condition, it should be emphasized that the yield point-tensile strength relation is generally higher for the steels of the present process than for killed open hearth steels. Tests also indicated creep strength for silicon killed steels blown by the high purity oxygen method to be somewhat higher than silicon killed open hearth steel of equal strength.

In many other instances, the steels produced by the present invention have been proven by test to be at least comparable to open hearth steels, among which may be mentioned killed low carbon plate steel having good weldability and resistance to aging, heat-treatment (hardenable) steels, case hardening steels, and rail steels.

It is also an advantage of the present invention that plain carbon steels may be produced directly by the process, since it is possible to "catch" the heat at higher carbon contents due to the rapid removal of phosphorus and sulfur, although such steels may also be produced by blowing to the normal carbon end point of .05 to 0.10 percent C and recarburizing.

Considering refining capacity alone, and refining rates as given above for the process of the invention, one continously operating 30 ton (metric) converter will produce from 35 to 55 tons (metric) per hour, depending upon hot metal analysis. To achieve an equal tonnage of steel per hour in an open hearth plant, two large size units of about 250 tons charging capacity would have to be operated continuously. These figures establish that the process of the invention provides a definite capital cost advantage over the conventional open hearth process, even including the relatively high cost of the oxygen plant.

With the development of the new refining process of the invention, there is made available a new steel making tool which permits steels of excellent quality to be produced under favorable conditions, including high productivity per unit, comparatively low capital outlay for plant, and low cost of production, and good flexibility with regard to available resources of charging materials.

Various modifications may be made to the process without departing from the spirit of the invention. For example, in certain instances where nitrogen contents of greater than .003–.004 percent may be tolerated, oxygen somewhat below 98% may be utilized to produce steels having nitrogen contents of from 0.010 to 0.015 exhibiting the characteristic of relatively high strain hardening. Also, the process may be conducted with use of oxygen of from 95 to 98 percent in the first portion of the blow followed by finishing of the blow with high purity oxygen of 98 percent or higher, the vigorous boiling action of the bath up to the carbon end point insuring removal of nitrogen under such conditions. The term "high purity oxygen" is intended to mean at least 97 percent oxygen.

In the foregoing specification and in the appended claims, the term "directly above" with respect to the impingement of the oxygen jet on the bath surface is intended to mean that the oxygen jet issues from an overhung blast nozzle or other oxygen jet producing means in contradistinction to the disposition of lances or tuyeres positioned in the sidewalls of the refining vessel above the melt line for relatively low angle impingement on the melt surface.



As indicated above, the energy of the jet in the initial stages or first few minutes of the blow, may exceed the defined specific surface pressure of the jet on the melt surface, particularly where an unusually thick or stiff slag cover is encountered. However, the impact pressure of the jet is maintained in accordance with the foregoing teachings throughout the major portion of the blow, and particularly during the later stages thereof. Reference to "tons" where not indicated is to be interpreted as metric tons, and percentages, except as otherwise indicated, are percentages by weight.

This application is a continuation-in-part of our copending application Serial Number 277,061 filed March 17, 1952.

We claim:

1. A process for refining molten ferrous metal by surface blowing with gaseous oxygen in which the heat required for the refining is produced by reaction of the oxygen with the impurities in the molten metal, which comprises introducing into a reaction zone solid ferrous metal and a predominant proportion of molten carbon-containing ferrous metal, providing the molten metal with a slag cover, initially displacing the slag cover to provide direct contact of oxygen with said molten metal, blowing a jet of high purity oxygen from a blast nozzle substantially vertically downwardly onto the surface of said molten metal, said blast nozzle being spaced between about 150 millimeters and about 2000 millimeters above the surface of the molten metal, and controlling the impingement of the oxygen jet on the surface of said molten metal such that the impact pressure of the blast jet on a reference surface spaced from the blast nozzle a distance equal to the distance of the molten metal surface from the blast nozzle is maintained below about 0.75 kg./sq. cm., and above about 0.02 kg./sq. cm., while supplying the oxygen at a rate sufficient to complete the refining in about 12 to about 30 minutes.

2. A process according to claim 1 in which the pressure of the oxygen at the blast nozzle is reduced in the latter portion of the said refining period to reduce the rate of oxygen feed as the carbon end point is approached.

3. A process according to claim 1 in which the impact pressure of the blast jet on said reference surface is maintained below about 0.5 kg./sq. cm.

4. A process according to claim 1 in which the solid ferrous metal is scrap and is charged in amount up to about 30% of the total metallic charge.

5. A process according to claim 1 in which the slag cover is initially displaced by directing the oxygen jet against the slag-covered metal with an impact pressure on the reference surface of at least about 0.1 kg./sq. cm.

6. A process for refining predominantly pig iron-containing molten metal with gaseous oxygen in which the heat required for the refining is produced by reaction of the oxygen with the impurities in the molten metal, which comprises introducing into a reaction zone solid ferrous metal and a predominant proportion of molten pig iron, providing the molten metal with a slag cover, blowing a jet of high purity oxygen gas from a blast nozzle substantially vertically onto the surface of the slag covered molten metal at the central portion thereof to initially displace the slag in the area of jet impingement and to establish direct contact of the oxygen with the molten metal, said blast nozzle being spaced from about 150 millimeters to about 2000 millimeters above the surface of said molten metal, and controlling the impingement of the oxygen jet on the surface of said molten metal such that the average impact pressure of the blast jet in the impingement area measured on a reference surface equally spaced from the blast nozzle with respect to the distance of the blast nozzle from the surface of said molten metal is maintained below about 0.75 kg./sq. cm. and at least about 0.1 kg./sq. cm., while

*Appendix.*





supplying the oxygen at a rate sufficient to complete the refining in from about 12 to 30 minutes.


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| | | |
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UNITED STATES PATENT OFFICE

## CERTIFICATE OF CORRECTION

Patent No. 2,741,555 April 10, 1956

Otwin Cuscoleca et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 29, for "0.5 square inch" read —0.05 square inch—.

Signed and sealed this 24th day of July 1956.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

**Excerpts From Cuscoleca Patent 2,741,555 [DX-22]**

The invention relates to a process for refining pig iron in a converter or other suitable vessel, in which oxygen or other oxidizing gases or oxygen-containing gas mixtures are blown against the bath surface from above and the heat quantity required for the process is produced by the reaction of the oxygen with the impurities in the molten pig iron bath.

*Col. 1, line 15; cf. Suess, Col. 1, line 15; App. 813.**

It is accordingly a primary purpose and object of this invention to provide a process for the refining of primarily hot metal charges, that is, predominantly molten pig iron, with high purity gaseous oxygen in which controlled refining at substantially theoretical oxygen efficiency is accomplished.

*Col. 2, line 22; cf. Suess, Col. 2, line 52; App. 816.*

A further object is to provide a process for refining of molten pig iron with a surface blown high purity oxygen jet in which an exceptionally high refractory life is obtained.

*Col. 2, line 28; cf. Suess, Col. 2, line 59; App. 816.*

The invention also has as its object to provide a process of surface blowing molten pig iron with

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*References herein to Petitioners' Appendix are to the Suess patent reprint in letterpress type.

high purity oxygen in which the refining reactions and oxygen impingement on the melt surface are controlled in a manner such that over-oxidation of the melt is essentially avoided.

*Col. 2, line 32; cf. Suess, Col. 2, line 63; App. 816.*

It is still another object of the invention to provide a high purity oxygen refining process which is applicable to pig iron of widely varying chemical compositions, including in particular pig iron of analyses used in ordinary basic open-hearth practice, as well as those of higher silicon and phosphorus contents required for blowing in the acid Bessemer and basic Thomas converter processes to produce steels having analyses and qualities at least comparable to that of basic open-hearth steels. Another object of the invention is to provide a high purity oxygen refining process for production of steel of excellent quality at a high rate of production, substantially comparable to Bessemer or Thomas converter practice, for example, a blowing time of from 15 to 25 minutes for charges of from 30 to 40 tons to carbon end points of 0.05 percent or below. These and other objects and advantages of the invention will be apparent from the following detailed description of the process.

*Col. 2, line 37; cf. Suess, Col. 2, line 69; App. 816-17.*

The invention is based on the recognition that to ensure a perfect development of the reaction it is not necessary at all to conduct the blast jet against the bath with a kinetic energy so high that the

blast penetrates deeply into the bath, but that it is sufficient when the blast contacts the bare metal surface of the bath to enable the oxygen to react with the metal.

*Col. 3, line 31; cf. Suess, Col. 3, line 36; App. 817-18.*

The applicability of the process of the invention to grades of pig iron having analyses between that of typical basic open hearth and basic Bessemer iron is clearly shown by reference to the following steel production in which a hot metal charge analyzing as follows was blown under conditions similar to those set forth in Example 1: 3.61% C. 2.16% Mn, 0.46% Si, 0.856% P, 0.06% S. The blowing of this charge of rather unfavorable chemistry both with respect to normal open hearth practice and basic Bessemer yielded a steel having the following composition: 0.04% C, 0.15% Mn, 0.0% Si, 0.014% P, 0.04% S.

*Col. 9, line 59; cf. Suess, Col. 9, line 60; App. 830.*

The advantages of high oxygen efficiency and high refractory life are obtainable according to the process of the invention when the oxygen jet impinges on the central portion of the bath surface from directly above, that is, approximately vertically with specific surface pressures, as above set forth. Oxygen efficiencies calculated on the basis of total oxygen input compared to oxygen consumed in the bath reactions is approximately 95 percent.

*Col. 5, line 37; cf. Suess, Col. 5, line 30; App. 821.*

*Appendix.*

In the usual operation of the process, it is preferred to employ oxygen of a purity of at least 98 percent (by volume), preferably above, since this results in negligible nitrogen pick-up in the metal bath as shown by frequency curves based on the produced steel analyses indicating a peak or maximum at a nitrogen content of from 0.002 to 0.003 percent, with 95 percent of all heats blown showing a nitrogen content of 0.004 percent or less.

*Col. 6, line 38; cf. Suess, Col. 5, line 52; App. 824.*

The upper limit for the energy of the oxygen jet, however, is set thereby that the blast should not, or at least not deeply, penetrate into the metal bath, because it has been found by exhaustive tests that a deep penetration of the blast into the bath causes an oversupply of oxygen impairing the quality of the steel being produced, or causing excessive refractory wear on the refractory bottom.

*Col. 3, line 47; cf. Suess, Col. 3, line 73 and Col. 2, line 67; App. 818 and 816.*

In conducting the process in the manner set forth above, the zone of direct oxygen reaction is effectively confined to the central portion of the bath, and the endothermic reduction of FeO by carbon to form CO encompasses this zone affording protection to the vessel lining.

*Col. 5, line 69; cf. Suess, Col. 3, line 47 and Col. 12, line 16; App. 818 and 834.*

The vigorous boil, above-mentioned, continues up to the carbon end point, and together with the

induced circulation of the bath metal toward and away from the central zone of direct oxygen reaction, effectively counteracts any tendency to over-oxidation of the bath.

*Col. 6, line 71; cf. Suess, Col. 6, line 62 and Col. 12, line 20; App. 824 and 834.*

In application of the process to basic refining, the effective heating of the slag cover and metal bath from above, the FeO formed initially absorbed into the slag, and the boiling action setting in at an early stage of the process, are highly beneficial in that they promote the formation of an early fluid and highly oxidizing slag relatively high in reactive lime. This condition provides an accelerated rate of phosphorus and sulfur removal from the bath, leaving the steel very low in both elements. With normal open hearth pig irons having phosphorus contents ranging from about 0.1-0.35 per cent, and with correct lime additions, final phosphorus contents not higher than about 0.025 percent, and as low as 0.010 percent are obtained at the time the carbon end point is reached with a single slagging operation.

*Col. 6, line 49; cf. Suess, Col. 6, line 11; App. 823.*

When the flame dies and carbon combustion is completed, the bath becomes relatively quiet and intimate contact between slag and metal bath ceases. The turbulence of the bath and slag due to the low impact pressure of the oxygen stream impinging from directly above is insufficient to cause continuance of oxygen-metal reactions. As a result, steels

blown by the process of the invention do not suffer from the deteriorating effects of high oxygen (FeO) contents. Direct oxygen determination by the hot extraction method yielded oxygen contents of 0.04 percent maximum for heats that were blown to a carbon end point of from 0.05 to 0.10 percent C. Thus, the oxygen content of steels produced by the high purity oxygen blowing process compare very favorably with oxygen contents of basic open hearth steel in the same carbon range, and are definitely lower in oxygen content than bottom blown Bessemer steels using air, oxygen enriched air, oxygen and steam, or other gas mixture.

*Col. 6, line 75; cf. Suess, Col. 6, line 66; App. 824.*

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*Appendix.*

**Excerpts From "Oxygen Steel" Published By BOT In March, 1953 [DX-1]**

Moreover, experience has shown that, even in cases where heats were blown to give very low end carbon, it was not necessary to deoxidise in the ladle, a fact which in itself is proof of the low oxygen pick-up.This manifests an important feature of the oxygen steelmaking process: in contrast to the conventional converter processes where the oxygen contained in the air-blast is, by virtue of tuyere-bottom design, dispersed through the entire bath of hot metal and has thus to contend with an oversize reaction area, the oxygen melting process is characterized by a very restricted reaction zone, the so called "hot spot" which holds good even on deep penetration of the impinging oxygen jet. Thereby conditions are created for the progress of metallurgical reactions that very closely approach those of the open hearth process: the reaction takes place within a very restricted area, called the "impingement area", sustained by a bath circulation to and from that area and controlled by the evolution of carbon dioxide, and in this way any over oxidation of the bath is prevented.

**Excerpt From Letter Dated January 20, 1960, Kaiser To J&L [J&L Estoppel Ex. C]**

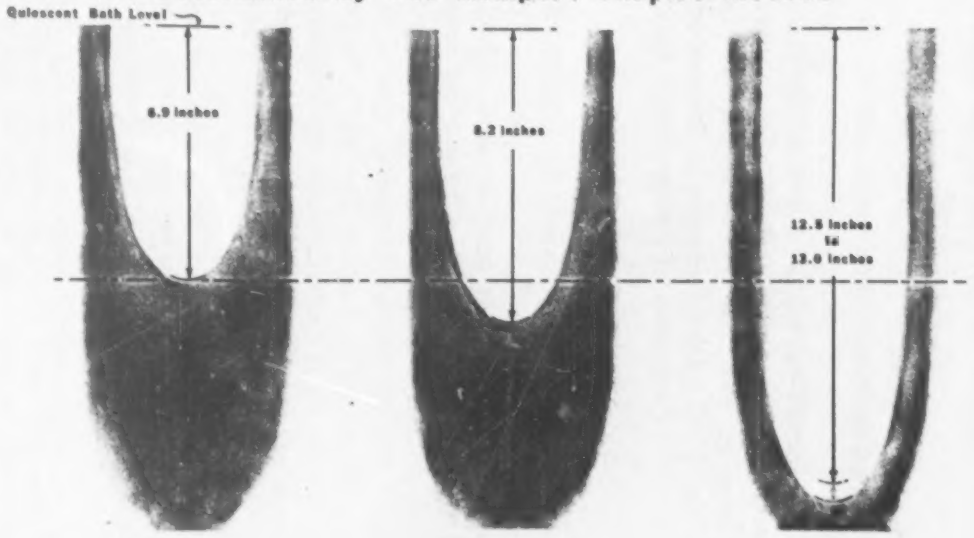
This is in answer to your letter of December 17, 1959, in which you question why we are not asserting the Cuscoleca patent in the action presently pending against McLouth Steel Corporation.

The Cuscoleca patent expires before the Suess patent, and as explained at our meeting on December 14, 1959, it was decided, as a matter of litigation and trial strategy, not to pursue the Cuscoleca patent against McLouth.

As mentioned at our meeting on December 14, we feel that in pursuing only the Suess patent against McLouth, we are using our best efforts as determined in our reasonable discretion to protect our patent rights in a manner which will prevent use thereof by others in competition with your company without a license.

DX-213

## Comparison Of Depth Of Indents
## As Determined By The Kemper / Shapiro Method




| Miles | Rinesch | Suess |
|---|---|---|
| British Pat. 642,084 | File Wrapper Affidavit | U.S. Patent 2,800,631 |
| ( DX-8 PX-458 ) | ( PX-2A pp. 79-80 ) | ( PX-1: Col. 9, lines 6-13; Col. 10, lines 46-49 McLouth TR. pp. 4317-8 [Dr. Shapiro] ) |

**Demonstration Of The Errors In The Lower Court's Calculations, Proferred At Deft. Br. 30 And Reply Br. 1, fn.**

The calculations we have challenged appear at App. 339*, fn. 40. The lower court there charges Dr. Flinn with having used in Demonstration No. 7, 27 times (and in Demonstration No. 9, 22 times) the amount of oxygen "recommended in Example 1 of the Suess patent, as that was calculated". It will now be demonstrated that the amount of oxygen used by Dr. Flinn was precisely that recommended in Example 1:**

— I —

The weight of the melt in Demonstration No. 7 was 270 pounds; and the Suess specification (col. 10, lines 72-75) tells us that the theoretical oxygen requirement per ton of melt is 51 cubic meters. In order to calculate the theoretical oxygen requirement, therefore, it is only necessary to convert 270 pounds to a fraction of a ton and multiply it by 51. The resulting figure must then be converted from cubic meters to cubic feet in order to compare it with the consumption of 235 cubic feet reported by Dr. Flinn.

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*References herein to the Pennsylvania District court opinion in Petitioners' Appendix have been substituted for the original references.

**Ancillary points are stated in appended Notes, referenced in the text as "Note A", etc.

Note: A table of metric equivalents, appearing at page 1424 of *Webster's Third New International Dictionary,* was annexed to the copies of this Demonstration which were submitted to the Third Circuit. It has not been included here.

The lower court went through that exercise but in doing so it appears to have confused metric units and English units and also to have made errors in simple arithmetic:

(a) The lower court's first error lay in its calculation that 270 pounds = 0.135 tons. The lower court arrived at that figure by assuming that a ton is 2,000 pounds (App. 338), completely overlooking the fact that the Suess patent speaks in *metric* tons (col. 10, line 29). The lower court should therefore have divided 270 by 2,200 and not by 2,000. The figure thus obtained is not 0.135 but *0.123* metric tons [Note A].

(b) The next step is to convert the figure of 51 cubic meters per ton into English units:

1 cubic meter = 1.31 cubic yards.

51 cubic meters are 1.31 x 51 = 66.81 cubic yards.

66.81 cubic yards are 27 x 66.81 = *1804* cubic feet.

(c) All that remains is to multiply 0.123 by 1804. This gives us *221* cubic feet as the *theoretical* oxygen requirement for Demonstration No. 7 [Note B].

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*Note A:* The actual figure is 2,204.6 pounds avoirdupois (Webster, p. 1424), a difference so small that it can properly be neglected in the computations herein.

*Note B:* Since the lower court's calculations in regard to Demonstration No. 9 are based upon the same erroneous premises as its calculations for No. 7, and its ultimate error is necessarily of the same order of magnitude, we do not deem it necessary to go through the arithmetic a second time.

The correct figure (221) is thus more than twenty-five times the figure (8.58) calculated by the lower court.

— II —

The ratio of oxygen theoretically required to oxygen actually consumed is a measure of efficiency of the process. We are told at col. 10, lines 71-75, that the oxygen efficiency in Example 1 of the patent was 95%, calculated thus:

51 cubic meters (theoretical) ÷ 54 cubic meters (actual) = 0.946 or 94.6%.

Calculating the oxygen efficiency in Demonstration No. 7 in similar fashion, we have:

221 cubic feet (theoretical) ÷ 235 cubic feet (actual) = 0.944 or 94.4%,

a difference of only 2/10 of 1%. A closer correspondence in experimental results can hardly be imagined.

— III —

Dr. Flinn's demonstration heats were therefore strictly comparable with Example 1 of the Suess patent; Dr. Elliott was reckless in asserting otherwise (see App. 336 and 339-41, fn. 41); and the lower court's criticisms of Dr. Flinn and Judge Freeman (App. 88-90; 336-40) were unwarranted [Note C].

* * * * * * *

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*Note C:* The lower court also criticized Dr. Flinn (App. 235, 338-39) for using a nozzle that did not comply with the prescription of 1 millimeter (1/25 inch) diameter per ton of charge, stated at col. 3, lines 59-61, of the Suess patent. The lower court made its criticism notwithstanding the *admission* that the teaching does not apply to heats of the size made by Dr. Flinn and by the plaintiffs themselves at Linz in June, 1949; see 257 F.Supp., at 423; Elliott (XIX: 13619, 13364, 13368-9); and patentee Hauttmann (XIII:9153, 9160-61) who patronizingly testified that "any expert" must know that this geometric relationship applies only within a small range, namely, 30-40 metric tons (cf. 338-40, fn. 41). Moreover, the plaintiffs appear not to have criticized Dr. Flinn's selection of the nozzle diameter used in Demonstrations 7 and 9. The lower court's criticism is therefore without substance.